POWER PLANT ENGINEERING

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

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MAY 15 1944
DETROIT

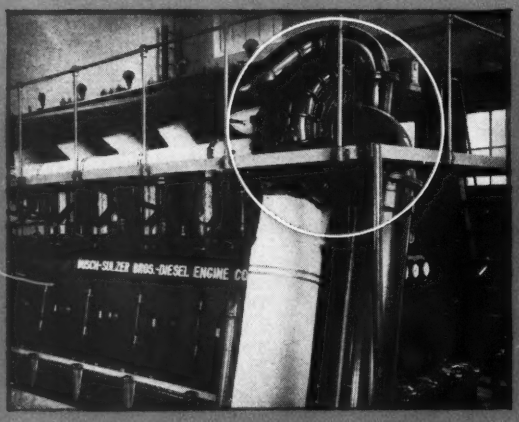
Architectural Trends In Power Plants
Boston Edison's Mystic Station
Don't Wince At Mathematics
Gas Turbines—Part 3

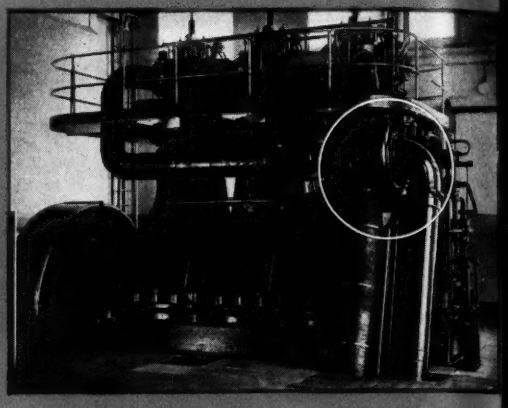
For Other Articles See Contents Page 5

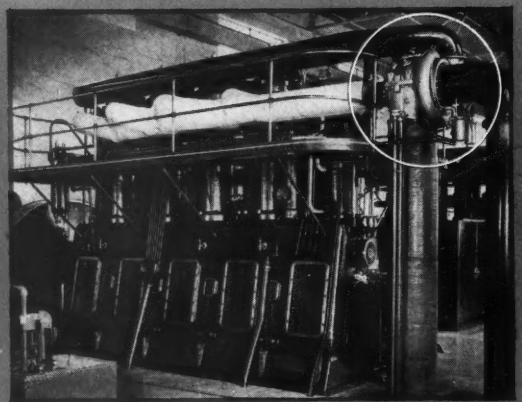
MAY 1944

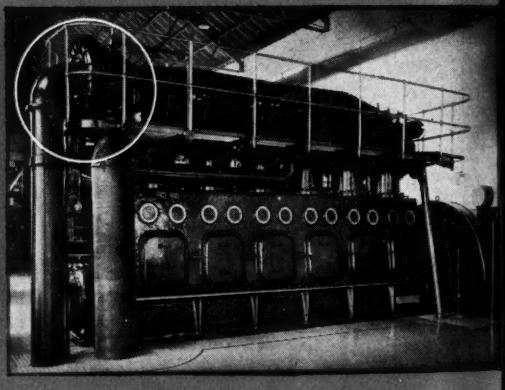
An executive of a large pipe line company *wrote*

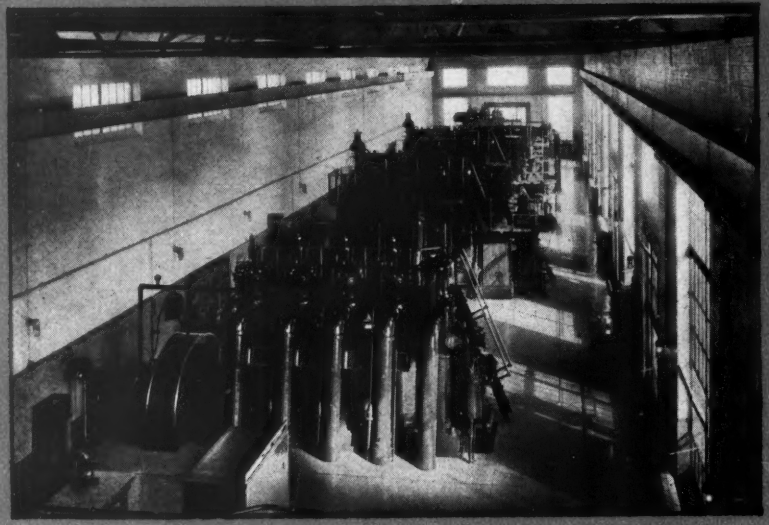
pumped 60(0 to
crude daily, du











Above are photos taken in stations of the pipe line company which stepped up movement of oil to the east, by adding Elliott-Buchi turbochargers to many of the Diesel engines in their pumping stations. Turbochargers are encircled.

0 to 9000 more barrels of y, due to Elliott turbochargers

DUBUQUE
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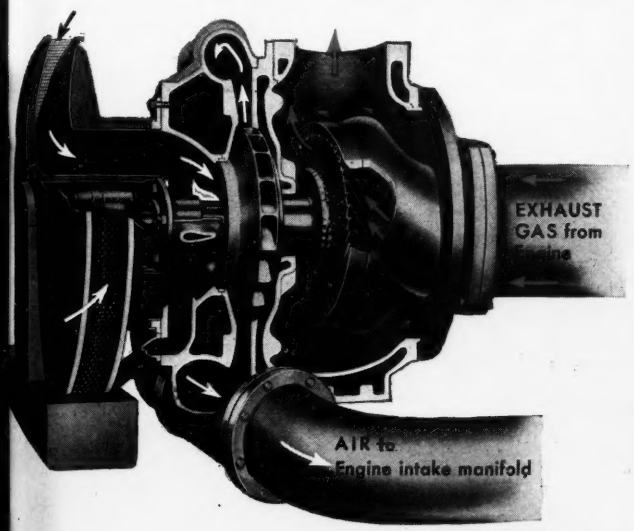

It was certainly an easy way to increase pipe line capacity, just when it was needed, when time was short, labor scarce, and materials difficult to obtain. The addition of Elliott-Buchi exhaust gas turbochargers to previously installed Diesel engines driving pumps stepped up oil movement to the east very definitely for this pipe line company. The increase is the equivalent capacity of two average size tankers, moving on a rapid prewar schedule.

While Elliott turbochargers are most effective when used with Diesels designed for their application, they still are vitally important power boosters on those previously installed 4-cycle engines. Many of these installations are now operating, all with gratifying success. These units are realizing up to 50 per cent more horsepower due to pressure charging and more efficient scavenging. Available for engine ratings above 250 hp — marine, stationary and locomotive.

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FOR ALL DIESEL ENGINES

TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

POWER PLANT ENGINEERING

Contents, May, 1944

VOLUME 48—NUMBER 5

Cover: An exterior view of the Curtiss-Wright Corp. Airplane Div. Power Plant at Louisville, Ky.

Front Lines 7
What Leaders Say 67
The Architectural Design of Power Plants 68
Engineering of Power Plants Determines Their Architecture 70
By F. K. Boomhower
Then—and Now 74
By F. K. Boomhower
How the Architect Works with the Power Engineer 78
By F. A. Fairbrother
Notes on the Architect's Procedure 81
By G. K. Scrymgeour
Architectural Studies for a Post-War Power Plant 82
Studies for an Industrial Power Plant 84
Notes on Power Plant Design 88
Architecture of Outdoor Plants 90
Don't Wince at the Math—Learn to Read It! 91
By W. C. Sealey and Mrs. B. M. Sealey
Boston Edison's Mystic Station 94
The Gas Turbine—Especially as Compared to the Steam Turbine 98
By F. K. Fischer and C. A. Meyer
Diesels of New Design by Hendy 102
The Practical Engineer and Electrician 103
Midwest Power Conference Views Progress 130
Growing Use of Alloy Steels 150
Anthracite Fines Being Investigated 152
SPAA to Meet in Pittsburgh 154
The MHO-Carrier Relaying Scheme 154
New Equipment 158
Obituaries 172
Manufacturers' Personals 176
Manufacturers' News 184
News from the Field 188
Helpful Bulletins 205
New Engineering Books 208
Power Plant Construction News 216

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FRONT LINES

RED FACE DEPARTMENT . . . A little comedy of errors, in connection with our correction note in Front Lines, February, 1944, page 7, column 1, paragraph 1, has been called to our attention by Velton V. Hubby of the Plains Plant, Phillips Petroleum Co., Borger, Texas. Mr. Hubby points out that in the above correction we referred to the original error as being in Front Lines, January, 1944, page 7, paragraph 2, sentence 2. This is an item about CMP regulations, instead of the statement we intended to correct. To get it all straight now, we hope, without stumbling over our editorial feet again, let us get it perfectly clear that the original error occurred in Front Lines, January, 1944, page 7, column 2, paragraph 2, sentence 2; or if you want to count right from the beginning of the page, it would be paragraph 5. To offset our crimson-visaged embarrassment, however, is our gratification in the fact that Mr. Hubby reads our Front Lines stuff. That always pleases an editor tremendously, even if he has to be embarrassed to find it out.

VAST QUANTITIES of valuable metals are lost annually by corrosion. Consequently, scientific studies of the mechanisms of corrosion are highly important because the exact way in which corrosion occurs may lead to more effective ways of overcoming it. Reporting on some recent research work before the Electrochemical Society, Dr. Herbert H. Uhlig, metallurgist of G-E Research Laboratory, reports that vacant spaces in the atoms of nickel are responsible for its resistance to corrosion or rusting. In earlier researches, he found that the stainlessness of stainless steel is not due primarily to the formation on the surface of a film of oxide, as formerly supposed. Instead it results from the electronic arrangement in the atoms of the alloy. Now he finds that the same thing is true for two other widely used corrosion-resistant alloys. One is copper and nickel, or Monel, and the other is molybdenum, nickel and iron, or Hastelloy. The relations of the electrons in the atoms of the various substances that produce these non-corrosive characteristics are somewhat complicated, but they lead directly to an explanation of why the mixtures of various elements in various proportions have the characteristics they are known to possess. The vacant spaces in the atoms allow electrons from the other substances to move in and change the characteristics. Thus the well-known scientific fact that the physical universe consists mostly of space has some very practical applications.

EVERY POWER ENGINEER and industrial plant engineer should obtain a copy of the new 7th Edition 1944 of a Table of Common Hazardous Chemicals, prepared by the Committee on Hazardous Chemicals and Explosives of the National Fire Protection Association and the American Chemical Society. This gives detailed tabulations on 98 hazardous chemicals with respect to their fire hazard, life hazard, recommended storage, and proper methods of fire fighting, with special recommendations as to suitable extinguishing agents for fires in chemicals which cannot be fought with water by ordinary methods because of chemical reaction with water. Copies of this table may be obtained from the National Fire Protection Association, 60 Batterymarch St., Boston 10, Mass., at thirty cents a copy.

GIVE AN ELECTRICAL ENGINEER a new and strange problem and chances are, says Dr. Simon Ramo in the March G-E Review, that "if he solves it at all he will have found an equivalent circuit for it. The phenomena might well be studied without an equivalent circuit, analyses might be carried through to a complete and correct answer without it—yet somehow the problem . . . is never accepted as a true member of the electrical-engineering family until the engineer can draw a diagram of a network of circuit constants whose performance will depict the characteristics of the actual problem." Dr. Ramo goes on to comment on the validity of the concept of equivalent circuits, referring particularly to an article in the same issue by J. F. McAllister, Jr., on equivalent circuits of the electromagnetic field, summarizing a great deal of the work that has been done on it, particularly by the famous Gabriel Kron. And now Kron shows that the space itself inside, say, a hollow-pipe wave guide, may be properly conceived of as filled with blocks of little impedance networks. Thus Kron proposes an equivalent circuit not alone for a line or wave guide or antenna, but for space itself. After a chat with him, concludes Dr. Ramo, one comes away almost convinced that one day the universe will all be clear: there will be an equivalent circuit for it.

IT IS NO LONGER necessary to junk aluminum, brass, bronze, copper or stainless steel castings and machined parts due to breaking of drills and taps in the machining process. The new Mechemel method makes possible a profitable salvage of practically 100 per cent on large and small parts. The method is an electrolytic process which disintegrates and dissolves the embedded fragment of tap or drill. Certain blocking agents in the solutions prevent electrolytic attack upon nonferrous metals and alloys so that there is positively no change in hole or thread dimensions when the broken fragment has been removed and the piece is ready for additional machining. A specially designed electronic unit, operating on 110-v, a-c, controls the process. Time required for the operation varies from a few minutes to several hours, depending upon size and length of the broken fragment, and the metal in which the fragment is embedded. However, the time element is of small importance, for one unskilled workman can remove up to three dozen taps at one time without constant attendance on the operation.

SPEAKING OF the possibilities of X-rays, Dr. William D. Coolidge, G-E vice-president in charge of research, in accepting the Franklin Medal awarded by the Franklin Institute recently, said that X-rays may be used as a thickness gage without the necessity of making mechanical contact with the work. For example, in the rolling of sheet steel where the sheet metal may be coming through the mill at over 20 miles an hour and at temperatures up to 2000 F and where, through adjustment of the mill, the thickness of the sheet must be kept within certain narrow limits, X-rays can be effectively used. With an X-ray outfit below and an ionization chamber or other X-ray intensity measuring device above the sheet, it becomes possible through the measurement of X-ray transmission to have a constant indication of thickness. If desired, the X-rays themselves can control the mill to maintain automatically a constant thickness of the sheet.

WE HAVE ALL heard a great deal about the perils of allowing our crude oil supplies in the ground to be decreased at the present rate. But how many of us know that certain precautions are already in use by the oil industry to recover the oil more efficiently and more completely, thus preventing waste and extending the supply? One way in which this is done is by pressure-maintenance of an oil field. This is sometimes done, where hydrostatic drive is used, by control of water movement into the reservoir to prevent possible trapping of oil. This greatly prolongs the time required to recover the oil. Another method is by injection of gas into the field. A successful example of this method, which recovered an additional 1,623,237 bbl of oil at the Wertz-Dome field of Sinclair Wyoming Oil Co. during the past two or three years, has been reported by The Cooper-Bessemer Corp. After a thorough study of the reservoir conditions in this case, it was calculated that 1400 cu ft of gas would be required to displace a barrel of oil. Thus, by returning to the deposit this volume of gas for each barrel of oil over the normal daily output of 3300 bbl, recovery could theoretically be sustained at any rate desired without decline of pressure, and, by returning a greater volume of gas, the output could be increased. Gas is injected to the formation through tubing by means of three gas-fueled Cooper-Bessemer compressor units totalling 1800 hp. To obtain the present high rate of oil production 4,280,000 cu ft of gas is pumped daily to the pools at a discharge pressure of 1825 psi.

RIGHT UP in the front lines of post war planning is Scott & Fetzer Co. of Cleveland, Ohio, manufacturers of vacuum cleaners. According to the C.E.D. News, the president of this company, G. H. Scott, recently sent a letter to prewar suppliers placing an order for initial requirements in the post war period, subject to government regulations and leaving the price open. "Your fair dealing in past years warrants our confidence in the future," wrote Mr. Scott. Comments from the suppliers indicated that this was in some cases the first concrete evidence they had received that anybody was planning anything for the post war period and they expressed appreciation of the confidence reposed in them. Whether this is the right way to do it or not, we don't pretend to know. But we *are* certain that it is better than doing nothing.

IN ITS REPORT of The Engineering Foundation on current activities, included in its annual report 1942-1943, will be found interesting comments on some of the work carried on as research projects in cooperation with various engineering societies. Attention is called to the work on critical pressure steam boilers, Project 50, under the supervision of Professor Solberg of Purdue, although some of this work is not supported by the Foundation but is an extension of a project previously reported. A new research project was initiated on Temperature Distribution in Tube Walls subjected to high rates of heat input, one on Corrosion of Alloy Steels by High Temperature Steam was supported over a period of years, and another project on the coefficient of linear expansion of alloy steels was carried on by building apparatus and conducting some tests at temperatures up to 2000 F. In Fluid Meters, Project 30, the first three items of the volumeter program have been completed. Research work has been done on Effect of Pulsations on Differential Head Meters. The Engineering Foundation has headquarters in the Engineering Building, 29 West 39th St., New York City.

A NEW TWIST has been added to the time-honored method of testing castings or forgings by hitting them with a hammer, according to Ohmite News. When the piece to be tested is struck, the sound is picked up by a microphone and amplified. A filter then suppresses the harmonic frequencies. The remaining base frequency determines whether or not the casting or forging is defective because there is a variation in base frequency between a defective and a perfect specimen.

DEPARTMENT OF LIBERAL EDUCATION in the House Organs in 15 Minutes a Day. Octane Future, a review of the probable effects of the high-octane gasoline development on the postwar automobile, Industrial Bulletin of Arthur D. Little, Inc., March, 1944 * * * Our Flying Spies, detailed account of Army and Navy aerial reconnaissance operations; also Burma Road of the Air, a good story about our flying operations in India so much in the news today, illustrated with Kodachromes; also Air Giants in the Navy, a description of the Navy's sea-going Liberator that has helped to conquer the submarine; Plane Talk, March, 1944; Consolidated Vultee Aircraft Corp. * * * Turbines for TVA, a well illustrated story on some of the recent hydroelectric developments and their equipment; Baldwin, First Quarter 1944; The Baldwin Locomotive Works * * * Ball Bearing Applications to Vertical Shafts, showing in detail how they are installed and lubricated; The Dragon, March, 1944; The Fafnir Bearing Co. * * * Fuel Saved the Digester Way, how Hinde & Dauch Co. cooperates fully with Canada's Coal Administrator; The Power Specialist, January-February 1944; Johns-Manville * * * Wood for Sulphite Pulp, illustrated with some very fine detail photographs of the equipment used in preparing it; Oil-Power, March and April, 1944; Socony-Vacuum Oil Co., Inc. * * * Madame Curie 1867 to 1934, an account of her life and her important work in radioactivity; Cenco News Chats, March 1944; Central Scientific Co. * * * Electronics—A New User of Industrial Power; also Aircraft Jet Propulsion Systems; The Frontier, March 1944; Armour Research Foundation * * * Forging and Heat Treating 57 mm Gun Tubes; The Houghton Line, March 1944; E. F. Houghton & Co. * * * The Steel Foundry, from raw material to finished product with good illustrations of the equipment; Worthington News, February 1944; Worthington Pump & Machinery Corp. * * * General Business Conditions, Money and Banking and allied subjects, April 1944 report of the National City Bank of New York * * * Absorption of Heat by the Walls of a Furnace, detailed technical analysis of heat absorption in an oil fired boiler with two furnaces, one of which is a separately fired superheater furnace; Heat Engineering, January 1944; Foster Wheeler Corp. * * * Pumping 2,000,000 tons of Water a Day, detailed illustrated story on the way in which 14 large centrifugal pumps are at work unwatering Steep Rock Lake in northwestern Ontario, Canada, to expose submerged deposits of high-grade iron ore for mining; Compressed Air Magazine, April 1944.

UTOPIA in Reykjavik, Iceland, through a hot water line. The city of Reykjavik, now familiar to a goodly number of G.I. Joes, has had under construction for some years a heating system employing hot water, led from 32 wells sunk in rocky red lava at a point about 10 miles from the city. This water is transmitted by a 10-mile pipeline and the Icelanders hope that eventually every home in Reykjavik will be heated in this way. Details of this system are given by Hersteinn Palsson in a recent issue of the Saturday Evening Post.

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As a matter of operating efficiency this is obviously good practice at any time, but in wartime the possibility of conserving fuel takes on even greater importance.

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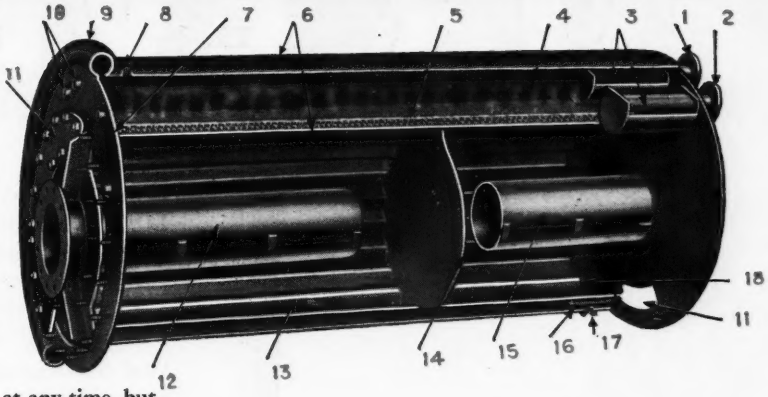
Maxim Silencers without the heat recovery feature are available for effective silencing of internal combustion engine exhaust or intake, steam engine exhaust, air compressor intake, vacuum pump discharge, blower intake and discharge. Engine exhaust silencers available with or without spark arrestor. Bulletins on request. Please give details.



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12—Inlet Bleeder Tube
13—Extended Heating Surface—forming conduits for leading exhaust gases from one attenuating chamber to the other
14—Insulated Intermediate Head
15—Outlet Bleeder Tube
16—Feed Water Deflector Plate
17—Feed Water Connection
18—Exhaust Gas Outlet from side conduits formed by extended heating surfaces

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ARMY E NAVY

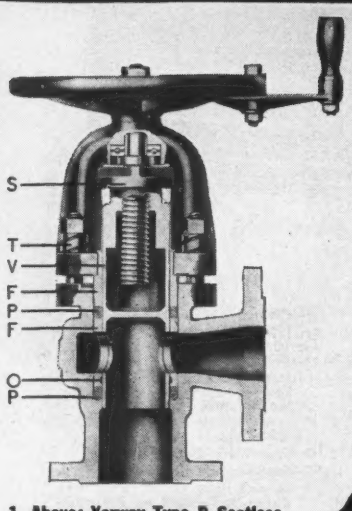
MAXIM

BLOW-OFF

At left, Yarway Seatless and Double-Tightening Valves in Tandem, for pressures up to 250 lb

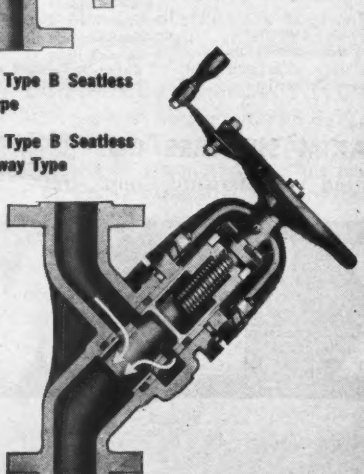
At right, Yarway Seatless Tandem for pressures up to 400 lb

FOR EVERY



1. Above: Yarway Type B Seatless Valve, Angle Type

2. Below: Yarway Type B Seatless Valve, Straightway Type



Yarway offers a complete Blow-Off Valve Service—FOUR DISTINCT TYPES OF VALVES to answer the Blow-Down Requirements of every steam plant.

Each is the product of more than a quarter-century of mechanical and metallurgical research—of practical field experience with more than 12,000 installations—of a determination continually to lead the Industry with the finest blow-down equipment that can be produced.

Because the Yarway line is complete you may be sure Yarway recommendations will be unbiased, based on honest judgment that the type valve selected will give long, trouble-free, money-saving service on the job.

Write for catalog; For pressures up to 400 lb, Section 424; For higher pressures, Section 431.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

YARWAY

VALVES

At left, Yarway Seatless Tandem for pressures up to 900 lb

At left, Yarway Unit Tandem —a Seatless and Hard-Seat Valve combination using one common forged steel body. For pressures up to 1500 lb

PRESSURE

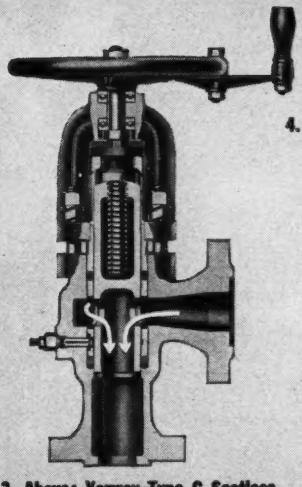
Yarway Type B Seatless Valves are of balanced, sliding plunger design. Made in Angle (Fig. 1) and Straightway (Fig. 2) Types. Operation of Yarway Seatless Valves: After valve is closed, shoulder S on plunger V contacts with upper follower gland F, forcing it down into body and compressing packings P, above and below port, making an absolutely tight valve. Yoke springs T maintain continuous pressure through follower glands F, on packing rings P. Annular groove O connects with alemite fitting for lubricating plunger and packing; alemite lubrication also provided for stem.

•

Yarway Type C Seatless Valves (Fig. 3) are made in both angle and straightway types. In this design the longer plunger protects the packing from blow-down at all times. Other features are laminated packing with stainless steel inserts, nitralloy plungers, alemite lubrication, ball thrust bearings.

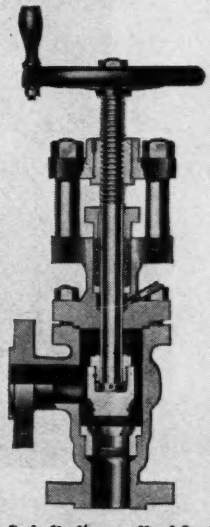
•

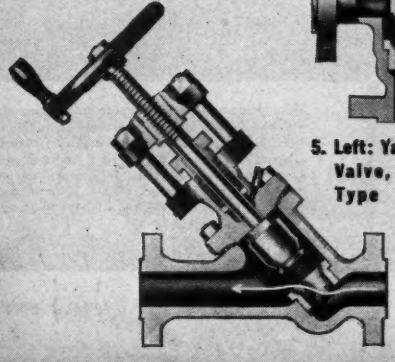
Yarway Hard-Seat Blow-Off Valves are of cone seat and disc type, having metal-to-metal contact. These valves are made in angle type (Fig. 4) and straightway easy flow type (Fig. 5). Features of the Yarway Hard-Seat Valve include: Marine and cast steel type yoke with threaded bushing, packing gland with bronze liner, large packing space, long-shank stem. Disc and seat ring are stainless steel; beveled faces have stellite inserts which provide smooth, hard-wearing surfaces at this important point.



3. Above: Yarway Type C Seatless Valve, Angle Type

4. Below: Yarway Hard-Seat Valve, Angle Type





5. Left: Yarway Hard-Seat Valve, Straightway Type

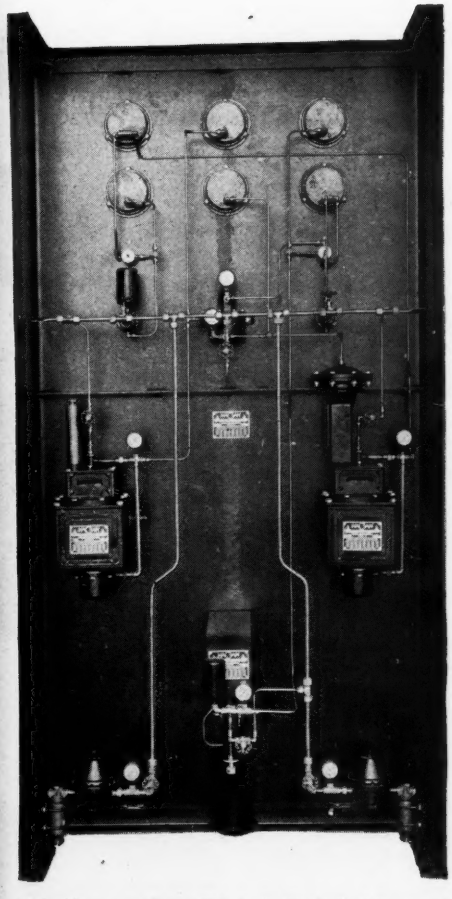
BLOW-OFF VALVES

...here is

NO ABSENTEE PROBLEM WHEN HAGAN CONTROL IS *on the job!*

This Hagan "Operating crew" is on the job 24 hours a day and no time off for sickness. Its quick response to changes in steam demand saves you up to 10% in fuel consumption. If your skilled operators are off work or called to war, Hagan Control will go on operating the plant at highest efficiency.

round-the-clock worker who doesn't know the meaning of unscheduled lay-off!



Thinks like an engineer. This is the "brains" of the control system—the Master sender which detects load changes and sends the impulses that regulate fuel and air to the most efficient quantities.

IF you could have enough trained men around to do what this famous control system does, they could not do it as well, as reliably or as fast. Certainly not as economically! For this equipment, which "thinks like an engineer and acts instantly," goes on operating efficiently even if some of your operators are absent. It is so simplified as to be almost fool-proof . . . so dependable you have practically nothing to do with it but watch results.

Thousands of America's war industries can thank their stars today that they were farsighted enough to have Hagan installations functioning when the demand came for vastly increased production. They knew it would give them all the steam their boilers were capable of producing and give it as needed, according to the demand.

Hagan Automatic Control is one of the investments in equipment which management really likes to make. It not only starts paying dividends *at once* but will keep on doing so for many years to come.

May we tell you more about it?

HAGAN
HALL
BUROMIN
CALGON

HAGAN CORPORATION · HAGAN BUILDING · PITTSBURGH 30, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

"Our IRON FIREMAN

save 20% in coal, 30%

—estimates J. R. Burke, maintenance foreman, Pittsburg

PITTSBURGH PLANT MODERNIZES BOILER ROOM

IN the summer of 1940 the Pittsburgh Equitable Meter Co., the world's largest manufacturer of water and gas meters, completely modernized its boiler plant. Due to the growth of company business, the old boiler plant was inefficient and inadequate to meet steam requirements, even in the handling of rated capacity. They wanted an efficient boiler room installation that would hold labor to a minimum, dispose of combustible refuse, and have a low maintenance cost.

To meet these requirements the company decided to install two Pacific No. 75-S-1 boilers having 2,143 square feet of heating surface and an E. D. R. rating of 36,431 square feet. The boilers are stokered with two Iron Fireman Poweram stokers of 1,600 pounds hourly coal burning capacity.

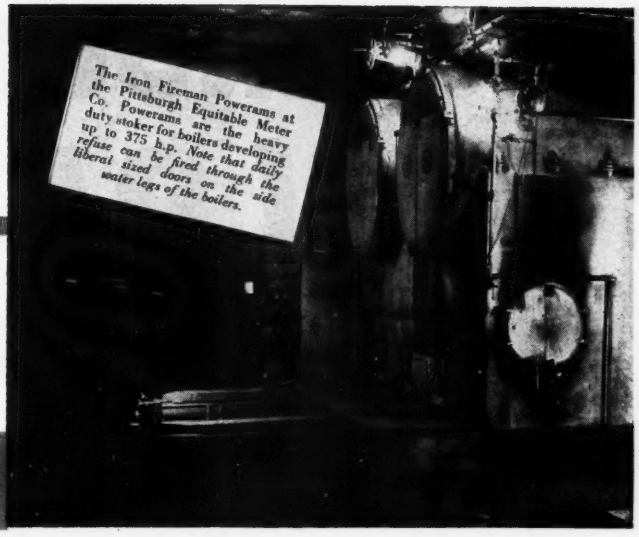
The Iron Fireman exclusive volumeter is highly responsive. Regardless of fuel bed conditions or the type of coal used, the Volumeter will always give the volume of air required.

The Iron Fireman stokers are equipped with motor driven forced draft fans. The forced draft air duct is equipped with a volumeter that meters the air for combustion in proper volume for the fuel burning rate. Variations in fuel bed resistance are automatically compensated for with no deficiency or excess of air, thus making possible high combustion efficiency.

...STOKERS

...% in labor"

...quitable Meter Company



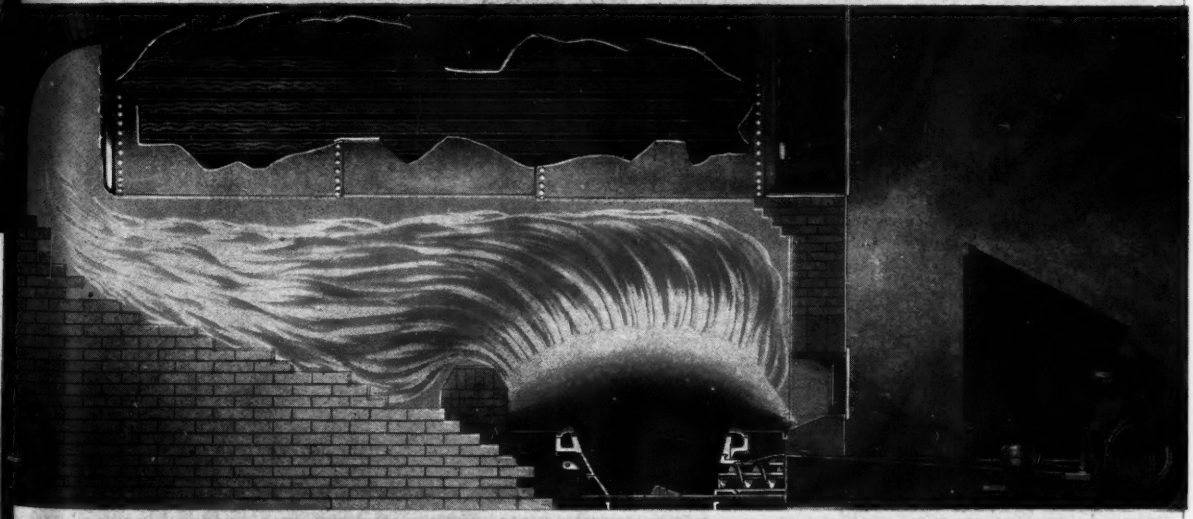
The Iron Fireman Powerams at the Pittsburgh Equitable Meter Co. Powerams are the heavy duty stoker for boilers developing up to 375 h.p. Note that daily refuse can be fired through the liberal sized doors on the side water legs of the boilers.

THE high combustion efficiency of the Iron Fireman stokers is responsible for a fuel saving of 20% over hand-firing at this plant. The Iron Fireman Poweram stokers installed here are of an extended design with a distance of 16 feet from the center line of the retort to the center line of the coal hopper. The extended design was selected so the coal hoppers could be filled directly from the coal bin, thus avoiding the wheeling of coal from the bin to hoppers located at the boiler front. This design helped to make the 30% reduction in labor.

The extended arrangement keeps the boiler room clean. There is no wheeling of coal, piling of it in front of boilers or shoveling.

Iron Fireman Stokers Available

Iron Fireman commercial and industrial stokers are in full wartime production. Our nationwide organization of qualified engineers and dealers will make a free survey to determine what Iron Fireman can do for you. Write the Iron Fireman Manufacturing Company, 3292 West 106th Street, Cleveland 11, Ohio.



The Iron Fireman Poweram design combines non-packing screw-conveying with reciprocating retort distribution. The reciprocating blocks in the bottom of the retort eject fuel from the retort and properly distribute it over the burning area of the stoker. The Iron Fireman slowly preheats the coal, bringing it up to the ignition temperature as it nears the top of the fuel bed. An Iron Fireman fired boiler is never choked with coal, nor is the fire allowed to unduly die down. Automatic controls insure the fuel supply necessary for current steam demands.

...IRON FIREMAN

THE IRON FIREMAN

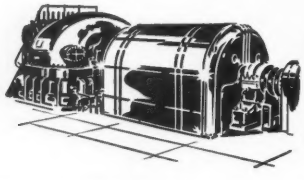
Automatic Coal Stokers

ANNOUNCING

NEW GARGOYLE

—to meet today's most Severe of greatly increased Steam

PROVED FAR



Now in service in Turbines ranging in size from 1500 KW. to 50,000 KW.

THE TREMENDOUS PROGRESS made in steam turbine design has resulted in the use of greatly increased steam pressures and steam temperatures. This increased heat subjects turbine oil to severe oxidation conditions.

To meet these new, severe requirements, Socony-Vacuum has developed a brand-new turbine oil, a great addition to the famous Gargoyle D.T.E. Oil line.

The base stock of this oil is in itself a high-grade turbine oil having great resistance to oxidation. Further resistance to oxidation plus anti-rust qualities are added to this excellent turbine oil by special processing. The result is the ideal turbine oil, Gargoyle D.T.E. Oil 797.

This new oil has already proved its superiority. In gruelling tests it surpassed all leading turbine oils in resistance to oxidation.

This oil is in service in turbines ranging in size from 1500 KW. to 50,000 KW. Ask your Socony-Vacuum representative for details.

SOCONY-VACUUM OIL COMPANY, INC. • Standard Oil of N.Y. Division • White Star Division Lubrite Division Chicago Division • White Eagle Division • Wadhams Division Magnolia Petroleum Co. • General Petroleum Corp. of Cal.

FROM THE WORLD'S LEADER IN LUBRICATION:

D.T.E. OIL

Turbine Operating Conditions Pressures and Temperatures.

SUPERIOR!

GARGOYLE

Lubricants

WHAT MAKES A GREAT TURBINE OIL?

√ ***Excellent Base Stock:*** The fundamental requirement for an ideal turbine oil is a base stock that in itself is an excellent turbine oil with excellent resistance to oxidation.

√ ***Extra Resistance to Oxidation:*** Oxidation protection—PLUS—is needed to meet the effect of greatly increased temperatures in modern turbine operation. Your turbine oil should have this PLUS protection.

√ ***Maximum Anti-Rust Qualities:*** The possibility of the presence of water demands that the oil should furnish maximum protection against corrosion. Your turbine oil should give this protection.

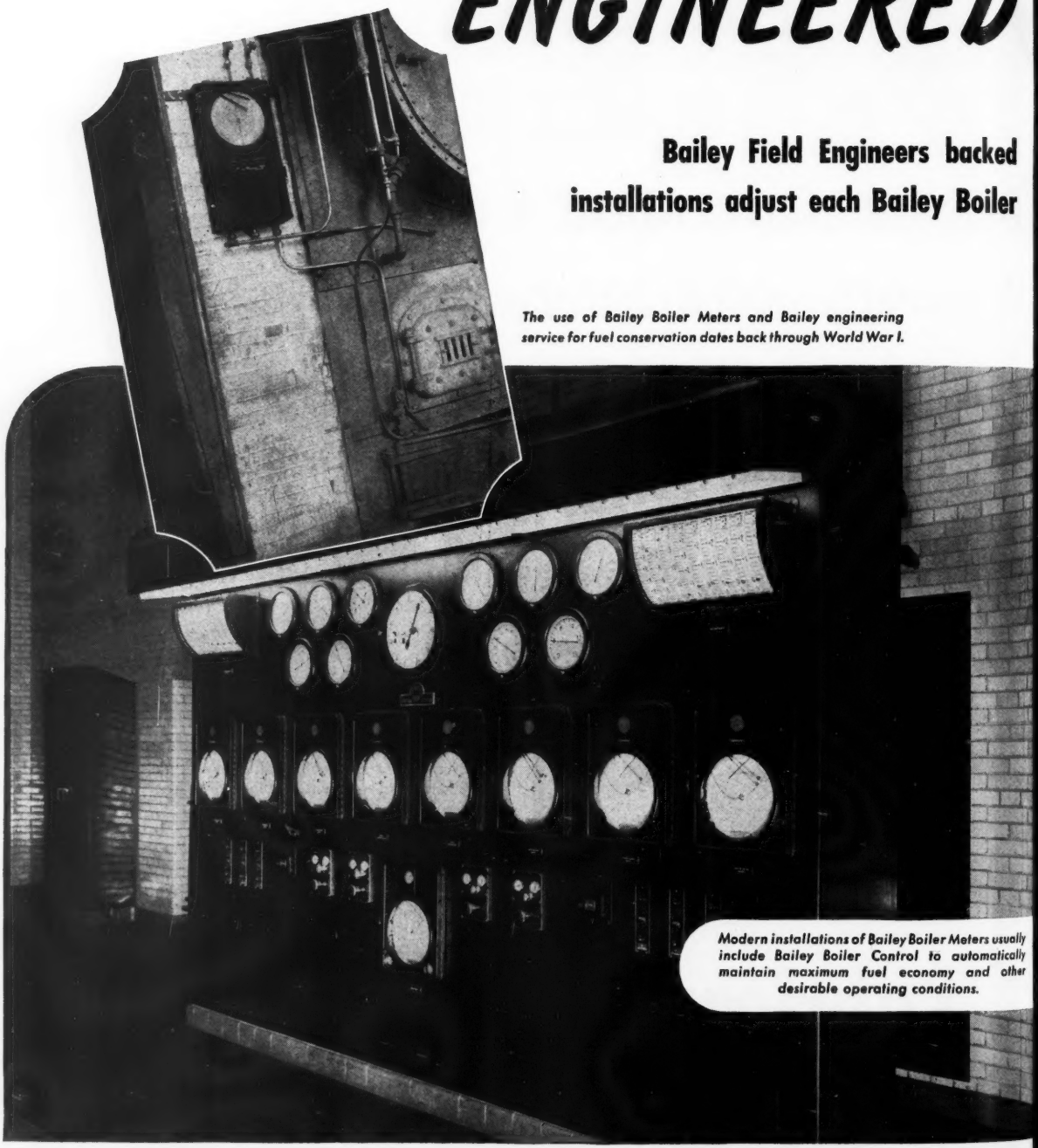
THE NEW GARGOYLE D.T.E. OIL 797 HAS ALL OF THESE NECESSARY CHARACTERISTICS

Socony-Vacuum Oil Company, Inc.

BAILEY BOILER METERS — ENGINEERED

Bailey Field Engineers backed installations adjust each Bailey Boiler

The use of Bailey Boiler Meters and Bailey engineering service for fuel conservation dates back through World War I.



Modern installations of Bailey Boiler Meters usually include Bailey Boiler Control to automatically maintain maximum fuel economy and other desirable operating conditions.

BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

—YOUR PASSPORT to FUEL CONSERVATION

by the **know-how gained from thousands of successful Steam Flow—Air Flow Meter to the particular requirements of the unit which it serves.** The meter then serves as a guide to firemen in obtaining maximum fuel conservation in everyday operation.

Bailey engineering service starts with the selection of equipment and continues through the design, construction, calibration, installation and final adjustment on the job. Much of this engineering work is done in the user's plant by Bailey Field Engineers who have been thoroughly trained in combustion and automatic control practice. These engineers are stationed in over 30 industrial areas throughout the United States and Canada for the purpose of rendering prompt "on the spot" engineering service without undue traveling expense.

The Bailey Engineer in your community has "know-how" at his command which was developed by over 25 years experience with the Steam Flow—Air Flow method of combustion control. This includes the records of tests on thousands of boiler installations covering a wide range of fuels, furnaces and fuel burning equipment. You will find that this engineer has more to offer than meters and controllers. He is primarily interested in helping you to secure maximum fuel conservation and other benefits which result from the intelligent use of correctly selected and properly applied instrumentation. G-21

BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND 10, OHIO
Bailey Meter Company Limited, Montreal, Canada

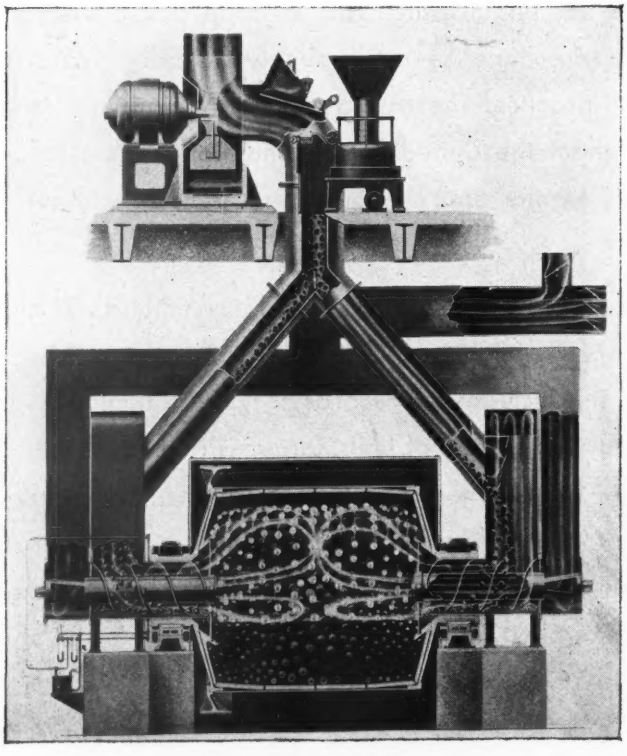
The Complete Combustion Control System

NTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Blazing THE Pulverized

Fuel Storage in Unit Systems

● When pulverized fuel was first commercialized, storage systems were provided for large installations to insure an ample available supply of pulverized fuel to meet sudden load swings. Unit systems were unsatisfactory as there was considerable lag between the time of change in feed rate to the mill and the change in amount of pulverized fuel available at the burner.



Development of the Foster Wheeler unit system incorporating the ball mill (Hardinge type) makes immediately available a six to eight minutes supply of pulverized fuel. This reservoir of prepared fuel is always maintained in the mill ready to meet additional demands of the boiler beyond the rate at which it is being operated. Rate of feed is governed by a controller which keeps a constant level of fuel in the mill.

Foster Wheeler is a Three-Star winner under the U.S. Navy Board of Awards for Production.

FW FOSTER

ENGINEERING TRAIL

Fuel Equipment

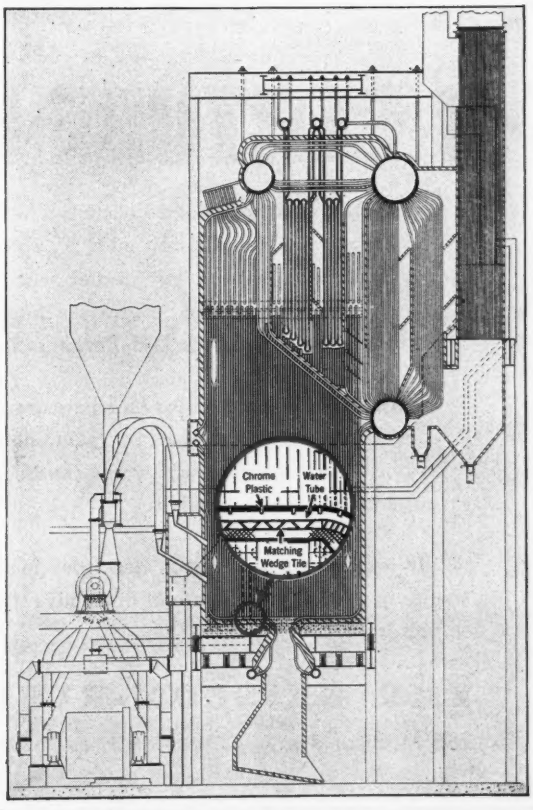
Flexible Floors for Slagging Furnaces

● The interlocking wedge tile construction for slagging furnace floors, originated by Foster Wheeler, has been highly successful for the past thirteen years.

The wedge tile design is used not only in continuous slag removal and intermittent slag tap furnaces, but also in both air and water cooled slagging furnace floors.

The advantages of this construction are:

1. Expansion difficulties eliminated as horizontal expansion is transferred to vertical movement.
2. Continuous tightness.
3. Long life.
4. Negligible maintenance.
5. No outages due to furnace floors.

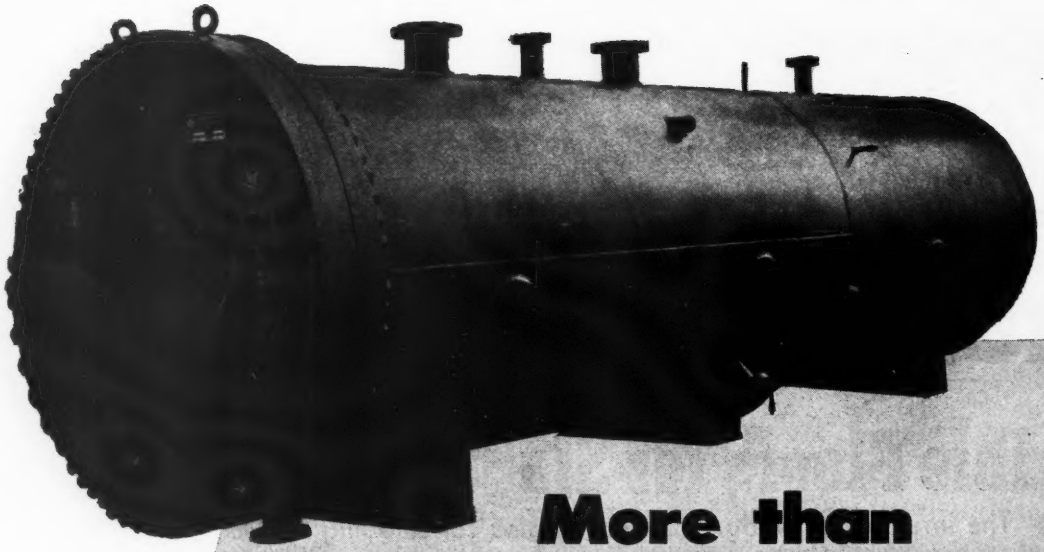


FOSTER WHEELER CORPORATION

165 BROADWAY

NEW YORK 6, N. Y.

WHEELER FW



More than 35,000,000 g. p. d.

pure boiler feed make-up are distilled by

G-R BENTUBE EVAPORATORS

This enormous total capacity . . . equivalent to the water supply requirements of a city with a population of more than a quarter of a million . . . and far greater than the total combined capacity of all other evaporator designs on the market . . . is striking evidence of the preference for G-R Bentube Evaporators.

Some of the reasons for this preference . . . proven dependability and economy of operation . . . sustained capacity and maintenance of purity with varying raw water conditions . . . combined simplicity, ruggedness, and accessibility .

Write for Bulletin 362, which describes in detail the patented scale-shedding elements and other distinctive features of this preferred evaporator.

THE GRISCOM-RUSSELL CO.

285 Madison Ave. New York 17, N. Y.

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus

SAVES TIME
FOR THE PIPING DESIGNER

Revised and Enlarged Edition

Simple and Easy to Use

Simplified Method for

CALCULATION OF PIPE WALL THICKNESS

for Various Pressures and Temperatures based on A.S.T.M. and A.P.I. Specifications and the A.S.A. Code for Pressure Piping

BULLETIN 43-A
Copyright 1943

Originated and Developed by Engineering Department

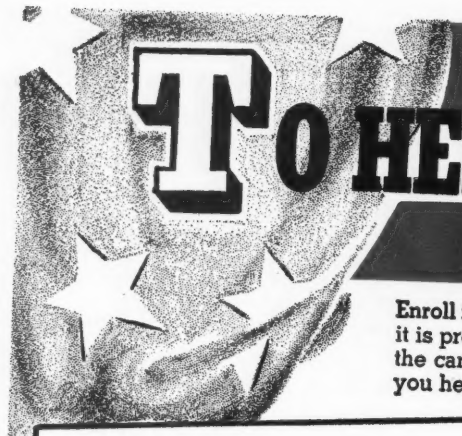
MIDWEST PIPING & SUPPLY CO., INC.
St. Louis 4, Mo., U.S.A.

This bulletin will enable you to determine quickly and easily the required pipe wall thicknesses for commercial pressure and temperature conditions. All you do is select a factor from a table, divide it into the working pressure and then refer the quotient to a chart. You have no substitution in formulae . . . no extensive calculations . . . no reference to codes or specifications.

This bulletin will gladly be sent to anyone interested who requests it upon a business letterhead. Simply mention Bulletin 43-A and address the main office at St. Louis, Missouri.

MIDWEST PIPING & SUPPLY CO., INC.
Main Office: 1450 South Second St., St. Louis 4, Mo.
Plants: St. Louis, Passaic (N. J.) and Los Angeles
Sales Offices: Chicago—645 Marquette Bldg. • Houston—229 Shell Bldg. • Los Angeles—520 Anderson St. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

PIPING FABRICATORS AND MANUFACTURERS OF PIPE WELDING FITTINGS



TO HELP YOUR COUNTRY

Enroll in the National Fuel Efficiency Program by signing this pledge when it is presented to you by a Regional Engineer who will identify himself by the card reproduced below. Welcome him, for his sole purpose is to help you help your country.

NATIONAL FUEL EFFICIENCY PROGRAM

in cooperation with the
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

In order to conserve fuel in our establishment and to prevent waste to help win the War:

We hereby enroll in the National Fuel Efficiency Program.

We hereby pledge ourselves to cooperate in this voluntary program.

We hereby agree to consider fuel-saving recommendations applicable to our operations.

Presented by

John Doe
Regional Engineer,
National Fuel Efficiency Program.

Date 3/28/44

District Heating Co.
Company
James Henry, Manager
Title
Ralph Jones
Waste Chaser
Spencer,
Address
Iowa.

Card No. 100

NATIONAL FUEL EFFICIENCY PROGRAM
CONDUCTED IN COOPERATION WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF MINES

This is to certify that

JOHN DOE
WHOSE SIGNATURE APPEARS HEREON, IS A REGIONAL ENGINEER COOPERATING IN THE PROGRAM OF FUEL CONSERVATION.

SIGNED William Smith Coordinator
TITLE
DATE 3/25/44 Spencer, Iowa
CITY

Note If you wish to expedite the visit of a Regional Engineer to your plant, write to the National Fuel Efficiency Program, New Interior Bldg., Washington, D. C.

COMBUSTION

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND HEATERS

will you enroll in this program?

The EMERGENCY The fuel situation is far more serious than most people realize. This applies to all fuels, including coal – our basic industrial fuel. There may soon be sections of the country with insufficient fuel for essential industrial operations, not to mention civilian needs. There are only two ways to answer this urgent national problem without curtailing production or imposing further restrictions – (1) make every pound of fuel do more work by increasing efficiency; (2) minimize heat losses in the boiler room and throughout the plant.

The PLAN A National Fuel Efficiency Program has been established and is now in operation. It is conducted by a Council, as listed opposite, in cooperation with the Bureau of Mines. Under this Council, coordinators in every section of the country direct a staff of hundreds of engineers – leading fuel experts. All of these men from top to bottom are giving their services without compensation. They will pool their technical experience and utilize the resources of the Bureau of Mines and other groups in their efforts to bring the most competent engineering recommendations to the plants they contact.

The GOAL The goal for the first season is to reduce commercial and industrial consumption of coal by 29,000,000 tons and of other fuels by proportionate amounts. To do this, regional engineers will endeavor to contact all possible boiler plants from small heating and commercial jobs up to large industrial installations.

Your PART When the bearer of the identification card, illustrated opposite, calls upon you, welcome him and give him your fullest cooperation. Assist him in getting the information he needs to analyze your conditions, read the helpful literature he will leave with or send you. (It has been prepared especially for this program by specialists on the operation and maintenance of the various classes of fuel burning, steam generating and related equipment.) Finally, follow through on the suggestions you will find in the literature and the recommendations that will be made to you. Put your own fuel conservation program into effect and make it work.

Your GAIN The satisfaction of knowing that you have made an important contribution to one of your country's most vital war problems, plus expert engineering advice, without charge, on ways and means of effecting savings and improvements in your plant operation.

This space is contributed by the undersigned company for the purpose of furthering the important work of the National Fuel Efficiency Program.

NATIONAL FUEL
EFFICIENCY COUNCIL

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SUPERVISING ENGINEER, NATIONAL FUEL EFFICIENCY SECTION, BUREAU OF MINES

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A-789

C-E **ENGINEERING**

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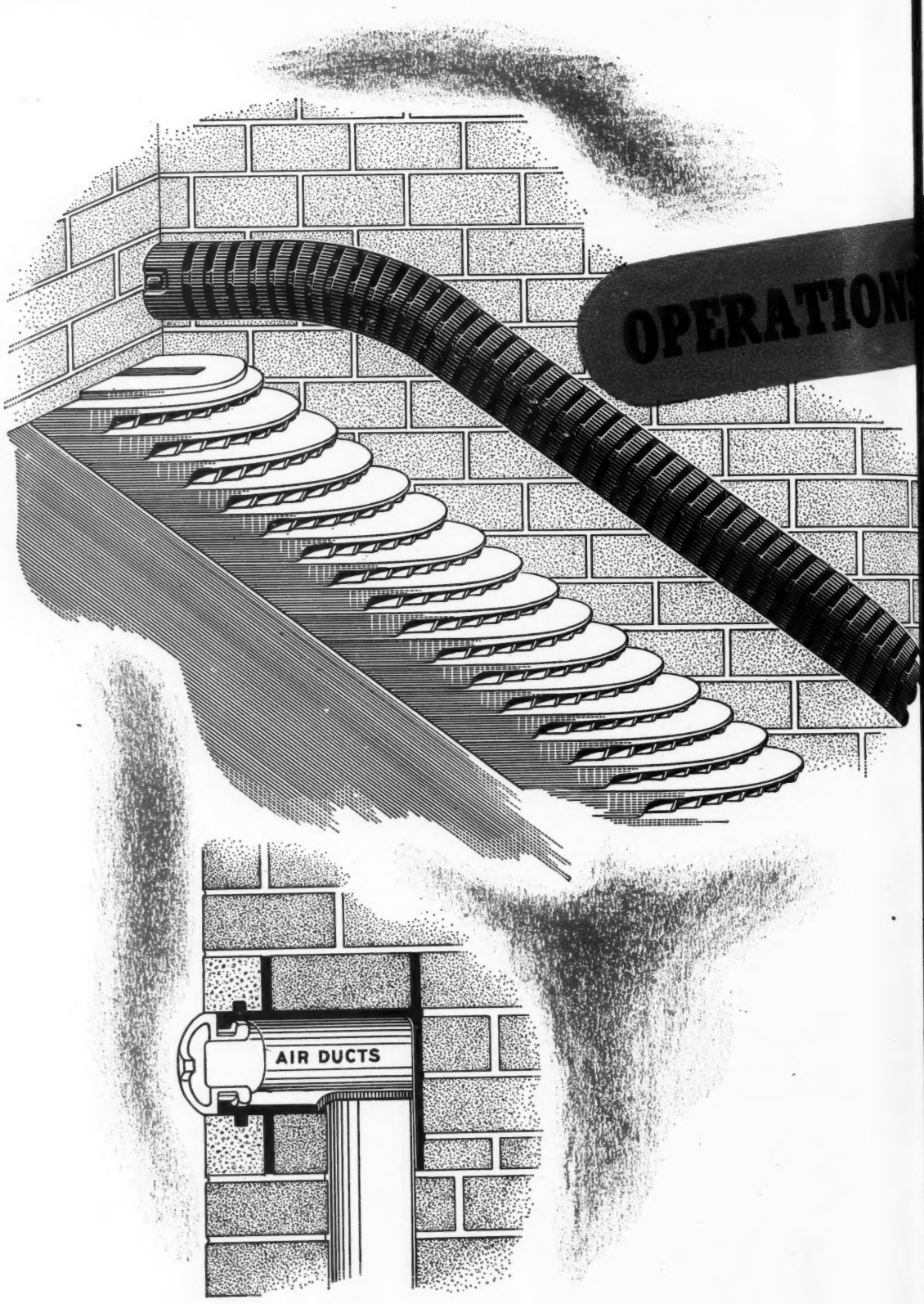
Canada: COMBUSTION ENGINEERING CORPORATION LIMITED, Montreal


OPERATIONS
AIR DUCTS

IMPROVED THESE 5 WAYS WITH

TAYLOR SIDE WALL AIR NOZZLES

WHERE water walls are not justified, the formation of clinkers on furnace side walls is a time-wasting and costly annoyance. Happily, however, there is a solution for these difficulties—Taylor Side Wall Air Nozzles. These nozzles, a product of years of Stoker engineering development, continually discharge a uniform screen of air that reduces side wall clinker formation. Stoker efficiency goes up, cost comes down.

At the same time Taylor nozzles offer other interesting features favoring economical operation, and reduced replacement and maintenance costs.

1. They are set in side walls below the hot zone and are at all times air cooled resulting in minimum maintenance and simplicity of replacement.
2. Brick work maintenance and labor costs are reduced due to counteracting of flame action and damage caused by hand removal.
3. Elimination of loss that occurs when boilers are off the line for repairs at other than regular cleaning periods.
4. Effect an increase in furnace capacity, making available space occupied by clinkers.
5. Operators find equipment more satisfactory, resulting in better performance. This simplifies the problem of getting and keeping the class of men you want.

The Side Wall Air Nozzle is one of many Taylor Stoker features combining to generate steam efficiently at a lower cost.

JUDGE THE SELECTION OF FUEL FIRING EQUIPMENT BY THESE TWELVE POINTS

1. RELIABILITY—the ability to operate with minimum outage and minimum standby equipment.

2. CAPACITY—the ability to provide adequate prime capacity ratings, with sufficient reserve capacity for emergencies.

3. MAINTENANCE—the ability to operate continuously with minimum repair costs.

4. FLEXIBILITY—the ability to follow the steam demand upward or downward . . . quickly and without sacrificing efficiency.

5. EFFICIENCY—the proved dollar efficiency (total cost of steam production) as shown by actual performance in similar installations.

6. OPERATION—the ability to operate continuously, the number and type of operations required, the ease of combustion adjustments, etc.

7. ADAPTABILITY—the ability to meet special and limiting conditions, present and future—structural limitations, utilization of present equipment, growth and change of power service demands.

8. FUEL FLEXIBILITY—the ability to burn efficiently and easily fuels from many sources having widely varying characteristics.

9. REFUSE DISPOSAL—the ability to economically eliminate ash or refuse and the opportunities of disposal at low cost, no cost, or profit.

10. STACK DISCHARGE—the practical elimination of "smoke nuisance" without special equipment.

11. SPACE REQUIREMENTS—the ability to conform to existing or future space limitations, to short and wide or long and narrow furnaces. Also the accessibility of component parts for maintenance and operation.

12. OBSOLESCENCE—the adaptability of the equipment toward possible future modernization with minimum of complication and outage.

A-E-CO TAYLOR STOKERS • LO-HED HOISTS
HELE-SHAW FLUID POWER • MARINE DECK AUXILIARIES

Æ co 75th ANNIVERSARY

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25 • PENNSYLVANIA

Corrosion

* This is the 10th of a series of informative messages concerning the meaning and significance of commonly used tests and terms employed to describe the characteristics of lubricating oils.

OIL IS AMMUNITION
USE IT WISELY !

DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

INDUSTRIAL TYCOL OILS-GREASES

SCIENTIFICALLY ENGINEERED FOR EVERY INDUSTRIAL USE

TYCOL

TIDE WATER LUBRICANIA

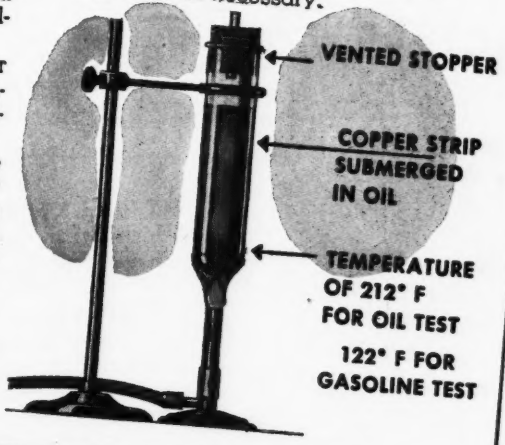
EXPLANATION: Petroleum products are frequently used in contact with metal, and when it is essential that the metal shall not be corroded, it is customary to require that the petroleum products pass an appropriate corrosion test.

TEST: The Copper Strip Corrosion Test as described in "Federal Specifications for Lubricants and Liquid Fuels" indicates the presence of free sulphur or corrosive sulphur compounds in undesirable quantities. It is conducted as follows: A clean strip of mechanically polished pure sheet copper about one-half inch wide and three inches long is placed in a clean test tube. Sufficient of the oil or liquid fuel to be tested is added to cover the copper strip completely. The test tube is closed with a vented stopper and maintained at a temperature of 212° F. for 3 hours. (If gasoline is being tested, then the temperature is held at 122° F. to avoid loss of product by distillation). The copper strip is then rinsed with sulphur-free acetone and compared with a similar strip of freshly polished copper.

The presence of free sulphur or corrosive sulphur compounds is indicated by the corrosion or discoloration of the test strip.

The sample does not "pass" the test if the discoloration of a freshly polished copper strip becomes opaque or if pitting is caused on any portion thereof. A slight discoloration is generally accepted as "passing" the test.

SIGNIFICANCE OF TEST: The Copper Strip Corrosion Test is an extremely sensitive test for indicating the presence of free sulphur or corrosive sulphur compounds in an oil. This test will detect concentrations of free sulphur as low as .001%. Variations in color of the copper strip may occur through a whole range of color shades with greens and reds predominating. Certain of these colors result from other reaction products than those caused by sulphur. These compounds may in no way be detrimental, and this fact should be taken into consideration when using this test to pass on the corrosive properties of an oil. Free sulphur colors the copper strip "black." The Copper Strip Corrosion Test is a desirable test for control of refining processes on certain types of petroleum products such as gasoline, Diesel fuel, Hypoid and All-Purpose Gear Lubricants, cutting oils and the like. It may also be used in the field for determining if sulphur compounds are present in certain oils containing additives when an active sulphur ingredient is necessary.



Tycol lubricants are made in a comprehensive line to meet each specific service requirement. Their repeatedly-proven ability to assure outstanding performance is the result of modern scientific manufacturing and rigid testing. Tide Water engineers will recommend the Tycol lubricant exactly suited to your needs – thus assuring truly efficient and economical lubrication.

TIDE WATER ASSOCIATED OIL COMPANY

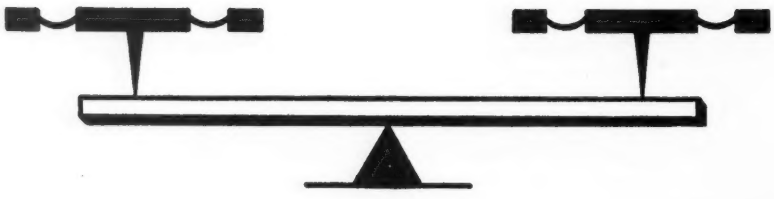
MAKERS OF THE FAMOUS VEEDOL MOTOR OIL • Eastern Division: 17 Battery Place, New York 4, N. Y.

***Principal Branch Offices:* Boston, Philadelphia, Pittsburgh, Charlotte, N. C.**

INDUSTRIAL LUBRICANTS

ACTION AND REACTION MUST BE EQUAL AND OPPOSITE

Recent developments in the application of the Force Balance principle offer some interesting and unique possibilities for the automatic regulation and measurement of flow—pressure—liquid level and temperature in your plant. Write us for details.



FORCE BALANCE

PRINCIPLE OF MEASUREMENT AND CONTROL

PERFORMANCE FEATURES

ACCURACY of the Republic Force Balance method of measurement is higher than can be consistently secured and maintained with any other method.

SENSITIVITY—due to the negligible motions required for complete operation of all parts for full scale change, no appreciable hysteresis results from reversal of direction of measurement change. The hysteresis loop is so small that it is undetectable by ordinary means, being less than 1/20 of 1%.

RESPONSIVENESS—due to the fact that there is virtually no volume displacement, the transmitter is able to follow flow changes almost instantaneously. The time required to produce full output pressure at the transmitter is in the nature of fractions of a second, after the force of the function being measured is imposed.

NO MERCURY is required, therefore, overrange cannot blow mercury or sealing liquid into the flow lines.

NO TEMPERATURE EFFECT—the effect of ambient temperature variations on the accuracy of the transmitter is negligible. Since all parts are equally affected by temperature changes, force and leverage relationships are not disturbed and accuracy is unimpaired.

The Smoot Engineering Corp., now a part of the Republic Flow Meters Co., were early pioneers in the application of the Force Balance principle to automatic metering and control equipment. The first Smoot regulators built in 1914 incorporated the Force Balance principle as have all Smoot (now Republic) regulators since that time.

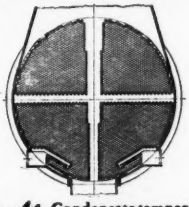
REPUBLIC FLOW METERS CO., 2224 Diversey Parkway, Chicago 47, Ill.

28 Years of C. H. Wheeler DUAL BANK CONDENSERS

KEEP PACE WITH IMPROVEMENTS IN TURBINE DESIGN

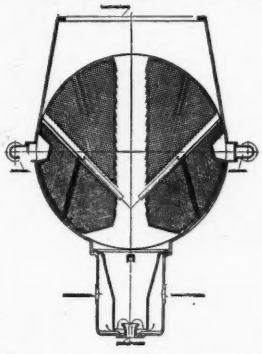
As the Steam Turbine was developed for higher vacuum, C. H. Wheeler Condensers kept apace of the same trend.

1916 **THE FIRST C. H. WHEELER CONDENSER** with which the steam ejector type air pumps were used is shown by this actual installation tube sheet.



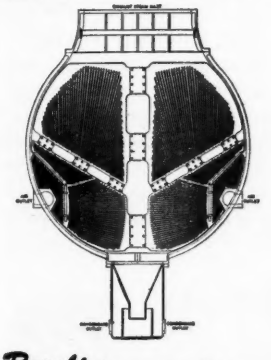
Result: Condensate temperatures within 5° of temperatures corresponding to vacuum.

1923 **IMPROVEMENT:** Wider steam lane and hotter condensate—shown in literature published at that time.



Result: This produced condensate temperature corresponding to temperature of vacuum and the oxygen content was less than 0.03 cc per litre.

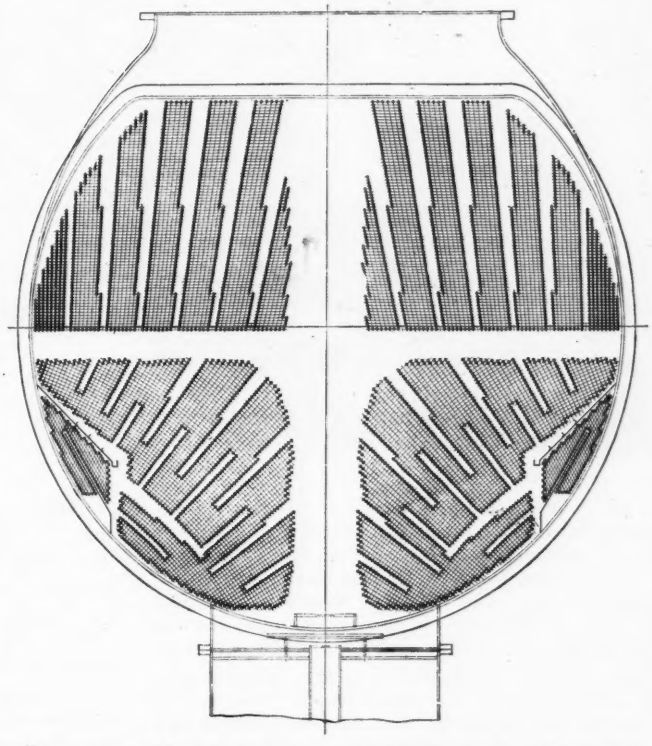
1929 **FURTHER IMPROVEMENT:** More open area for entering steam—illustrated in literature published at that time.



Result: Less pressure drop.

1944

NOW—Additional steam lanes give deeper penetration for the entering steam!



It is evident from the illustrations that the C. H. Wheeler Manufacturing Company has pioneered the development of this highly efficient Dual Bank Condenser.

PRODUCTS: Surface Condensers • Steam Jet Ejectors • Cooling Towers • Deck Machinery

C. H. WHEELER MANUFACTURING CO.

19th ST. *and* LEHIGH AVE., PHILADELPHIA, PA. *of Philadelphia*

FOUR OF 25 NEW DIESELS FOR MARITIME COMMISSION BEGIN OFFICIAL TEST RUNS

The photograph pictures a part of the big Busch-Sulzer plant in St. Louis. At the extreme left, one of the main propulsion engines for the Maritime Commission's Type C1-AV1 coastal cargo vessels is making its successful trial run. Next left, a second engine is nearly ready to turn over while the remaining two are rapidly nearing complete assembly.

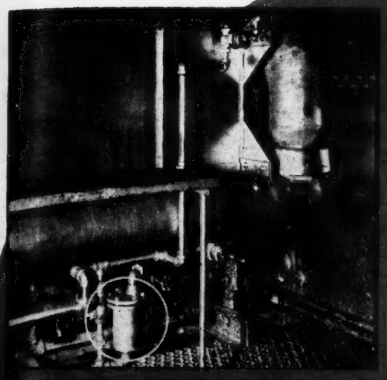
The C1-AV1 vessels will be used to move troops and materials to combat areas. Each of the twenty-five 4,000 ton ships with Busch-Sulzer Diesels will be propelled by a single direct-connected engine developing 1700 B. H. P. at 180 R. P. M.

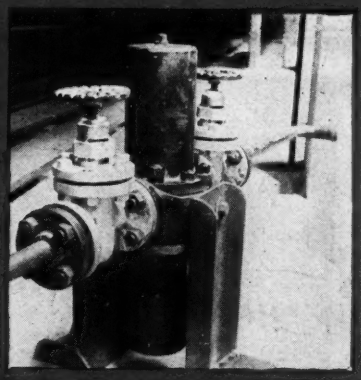
Busch-Sulzer also builds Diesels for other Maritime Commission ships and for vessels of the Army and Navy and marine and stationary engines for orders of high priority. Since a tremendous demand for Diesels is expected to continue for several years after hostilities cease, may we suggest that you acquaint us now with your requirements? We build 4-cycle engines up to 1500 B. H. P. and 2-cycle engines up to 7500 B. H. P. in sizes and speeds to suit a variety of needs. Your inquiry will receive prompt attention.

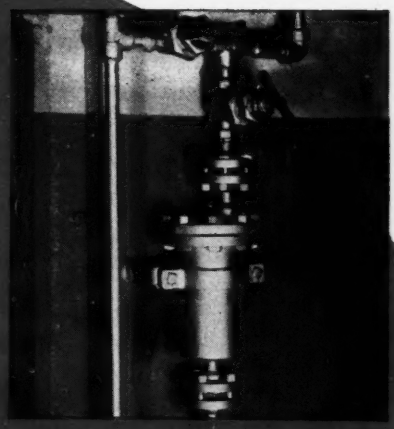
BUSCH-SULZER BROS.-DIESEL ENGINE COMPANY
SAINT LOUIS

AMERICA'S OLDEST BUILDER OF DIESEL ENGINES

BUSCH-SULZER ST. LOUIS







● The photographs show an exterior view of one of the many Armstrong-equipped central stations . . . applications of Armstrong high pressure traps in power plant and marine service . . . and an Armstrong compound trap draining steam header in a municipal plant.

The diagram: trap hookup providing protection for pressure reducing valve and desuperheater on high pressure steam line.

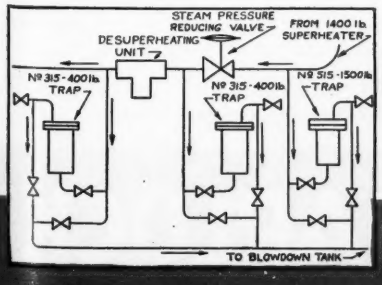
Armstrong *Inverted Bucket* TRAPS Standard for High Pressure Service

Way back in 1911 a boiler pressure of 125 lbs. was considered really "high pressure". And steam traps had developed no farther than these "high pressure" boilers. In that same year Armstrong built the first inverted bucket trap that sounded the death knell to such practically obsolete contraptions as pet cocks to prevent air binding and drain connections to get rid of sediment and sludge. For the first time engineers could install traps that were non air binding and self scrubbing — could install traps and forget them.

The rise in boiler pressures which began after World War I was paralleled by material and design improvements in the Armstrong Trap. To name a few: heat treated chrome steel valve parts replaced brass and bronze, steel forgings replaced castings, stainless steel buckets replaced brass. A frictionless leverage system replaced the original leverage design which took power to operate and time and money to maintain.

Because of these and other improvements, the Armstrong Traps are as modern as the high pressure boilers with which they are used. This is why so many high pressure Armstrong traps are in service and why the words Armstrong and steam trap are synonymous to power plant engineers.

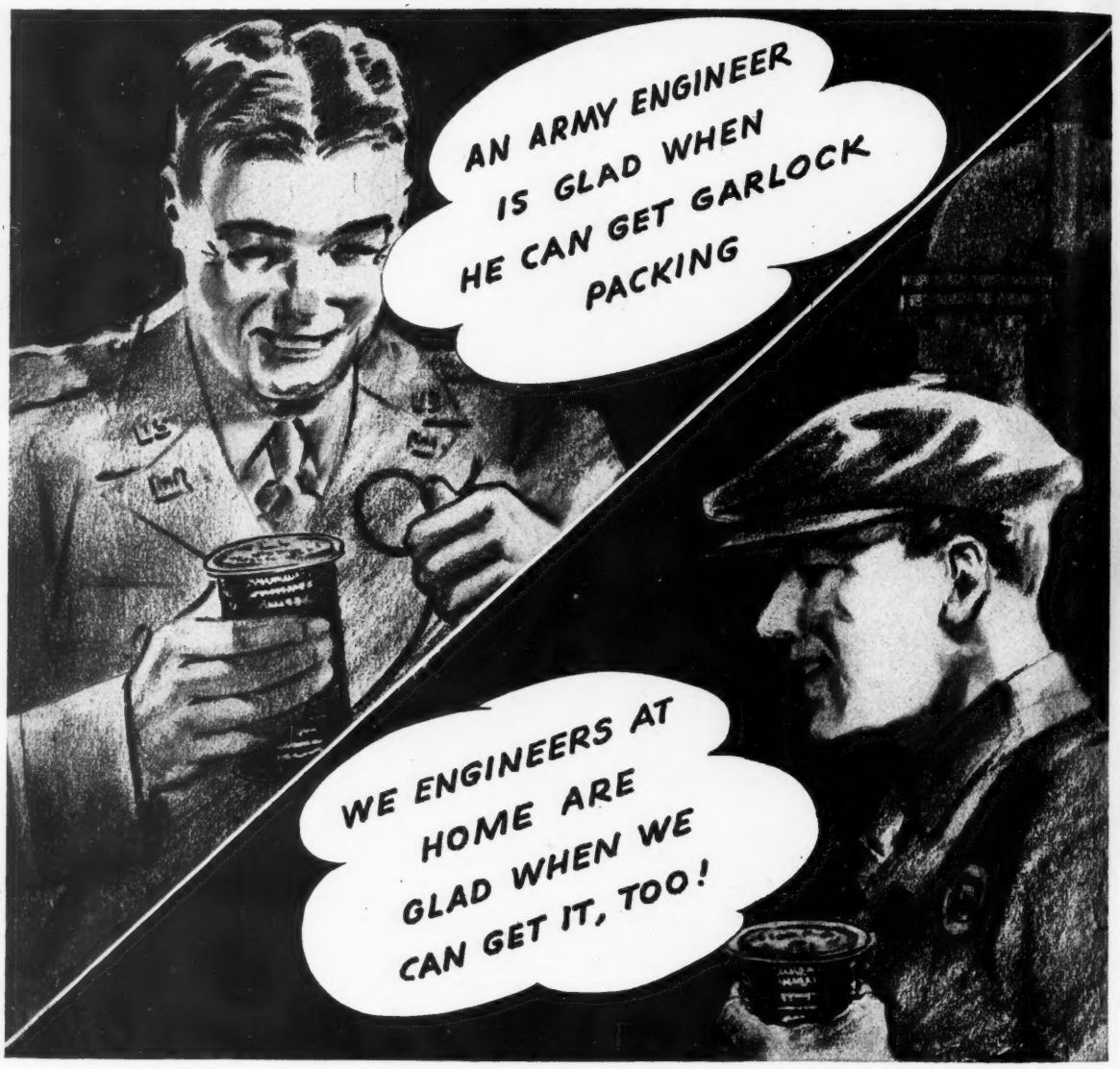
The Armstrong Steam Trap Book goes into detail as to design and contains complete data for sizing and installing high pressure traps. A copy is yours for the asking. Just write Armstrong Machine Works, 810 Maple Street, Three Rivers, Michigan.

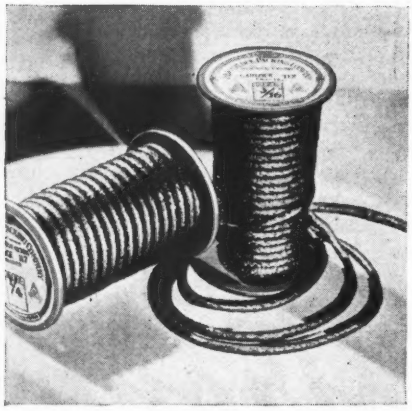

STEAM PRESSURE REDUCING VALVE
FROM 1400 lb. SUPERHEATER
DESUPERHEATING UNIT
№ 315 - 400 lb. TRAP
№ 315 - 400 lb. TRAP
№ 515 - 1500 lb. TRAP
TO BLOWDOWN TANK

ARMSTRONG STEAM TRAPS

Armstrong

The Original Inverted Bucket Steam Trap





GARLOCK 117 globe and angle valve stem packing is equally effective against high pressure steam, hot or cold water, or oil. Furnished either braided or twisted in all sizes from $\frac{1}{16}$" to $\frac{3}{4}$".

Backing the Attack on Both Fronts

GARLOCK Packings, Gaskets and KLOZURE Oil Seals are backing the attack on the battle fronts throughout the world. Engineers in the U.S. Armed Forces everywhere rely on GARLOCK dependable performance. And on the home front our war industries are taking advantage of the long, superior service of GARLOCK products to achieve top-speed production of planes, ships, guns, shells—for a quicker Victory.

THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

SENT HOME....

BECAUSE OF A *Shoestring* Plant Power System

COULD IT HAPPEN IN YOUR PLANT TOMORROW MORNING?

● **The sudden flash—the stalled machines—the catcalls of idle operators—the hurried conference at the desk of the maintenance chief—**

● **Then, the inevitable layoff—FOR PLANT POWER-SYSTEM REPAIRS!**

Today, many otherwise well-equipped plants are "getting by on a shoestring" in transporting electric energy from the point of entrance to individual departments and machines. Weak spots in the system remain undisclosed, until suddenly something *snaps!* Then, repairs that take days to complete may be necessary.

If your plant power system has been adapted and extended to handle loads that it was not orginally designed to meet, it may now be partly or wholly a "shoestring" system: containing make-shift circuits; circuit breakers and fuses with inadequate interrupting capacity; long, overloaded feeders.

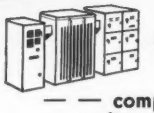
In addition to the outages you risk, such a system is often the overlooked cause of low production due to sluggish drives and poor lighting, and of high maintenance expense. Nurse it through for the time being if you must—but start planning now to replace it.

HERE'S *How* to plan for fully modern power distribution throughout your plant, using the G-E load-center system.

GENERAL ELECTRIC

BLOCKS of POWER*

right at each LOAD CENTER



* BLOCKS OF POWER

— — complete, compact, fully enclosed unit substations—are the basic elements of the G-E load-center distribution system for industrial plants.

In this system, plant power is distributed at high voltage to the substations, located at or near individual centers of power demand. Here it is transformed to a lower utilization voltage and distributed over short, individually protected feeder circuits.

Thus, you avoid the high costs and voltage drop that result from use of long, heavy low-voltage feeders from a single, remote substation. You have a fully co-ordinated system throughout.

The best investment in the world is in this country's future. Buy War Bonds

GENERAL ELECTRIC

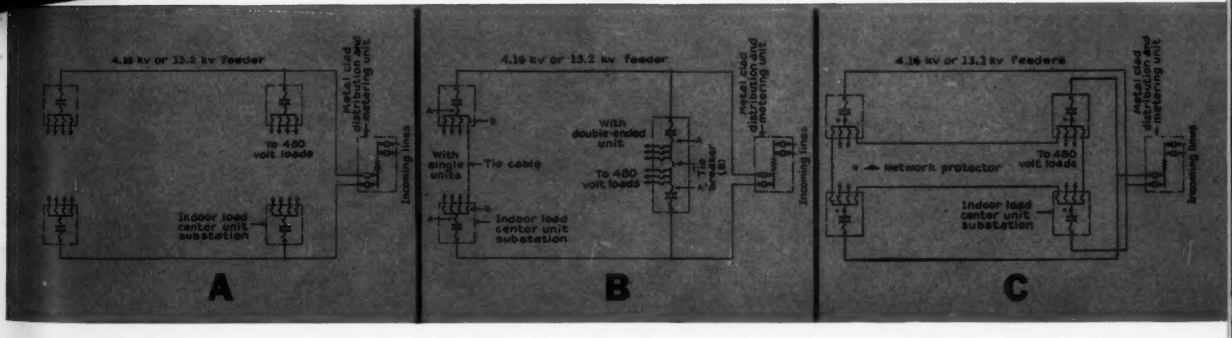
. . . safeguard your plant from CRIPPLING OUTAGES

The load-center distribution system—having G-E unit substations, and auxiliary equipment designed to tie-in with them—is the safe, modern way to guard against interruptions in power supply within your plant.

Even an inexpensive radial arrangement (see A below) is highly reliable when G-E unit substations are used, because the interrupting capacity of the switchgear is exactly matched with transformer capacity. *Self-protection* at each load center isolates most trouble within a single, short, low-voltage feeder circuit. And even when a primary circuit is opened at *one* substation, other load areas are not affected, and work can proceed as usual.

For still higher standards of service continuity, you can choose from a number of circuit arrangements such as the secondary selective (B) and the secondary network (C). The extra cost of this "service insurance" is far less than that of duplicate, long, low-voltage feeders from a single outdoor station.

Perhaps the biggest gain of all in avoiding power-system breakdowns comes from planning a co-ordinated system right from the start, using well-matched equipment of the proper capacity right where you want it. The load-center system permits you to make such a plan *now*, installing it complete, or block-by-block as a part of a gradual modernization project.



THE SIMPLE RADIAL arrangement consists of one or more load-center unit substations supplied by one primary feeder through one primary breaker. It is entirely adequate for the majority of installations. A radial circuit is low in cost and is extremely easy to operate. It offers a high degree of continuity when high-quality electric equipment is used throughout.

THE SECONDARY SELECTIVE arrangement uses duplicate primary feeders and transformers to supply each secondary load bus. Single-transformer unit substations are arranged in pairs (as shown at the left in the above diagram), or a double-transformer unit substation (as shown at the right) can be used.

THE SECONDARY NETWORK consists of two or more primary breakers and primary feeders, and two or more load-center unit substations, with the secondaries of the transformers operated in parallel through an inter-connecting grid. *Automatic* switching equipment disconnects a faulty transformer or primary feeder without any attention from an operator.

Get Started NOW for FUTURE PROTECTION
. . . Follow this Simple Plan

Plan Now for a *Fresh Start* in Plant Power Distribution

1 Begin with expected LOAD DENSITIES

Analyze today's power loads in terms of volt-amperes per square foot. Consider tomorrow's further electrification needs in each department.

2 Map out your LOAD-CENTER ZONES and FEEDERS

Subdivide floor areas in zones of 300 to 1000 kva, and determine the *service continuity* that each requires.

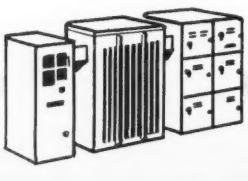
3 Work with G.E. on a "ONE-LINE DIAGRAM"

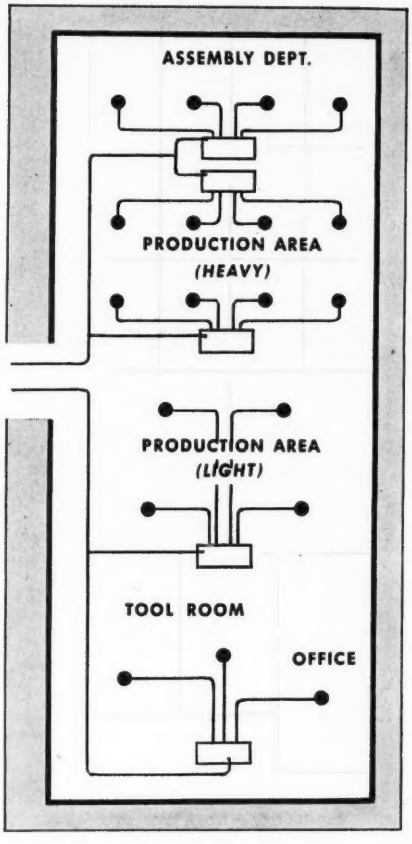
We'll sit down with you and your engineers to decide on the number and arrangement of unit substations, switchgear equipments, etc., and the interconnecting circuits you will ultimately want for a completely modern system.

4 Be ready to order STANDARD EQUIPMENT

G-E load-center power distribution equipment is built up by block-assembly from standard, repetitively-built designs. Once your "one-line diagram" is complete, you can begin modernizing step by step at your necessity or convenience, using well-matched standard equipment.

For further information on G-E unit substations as applied in load-center distribution systems, write for Bulletin GED-1006. *General Electric Company, Schenectady, N. Y.*





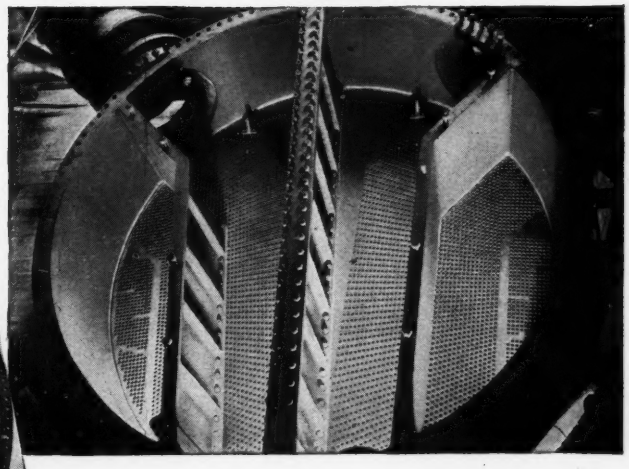
LOAD-CENTER POWER DISTRIBUTION SYSTEM

GENERAL ELECTRIC

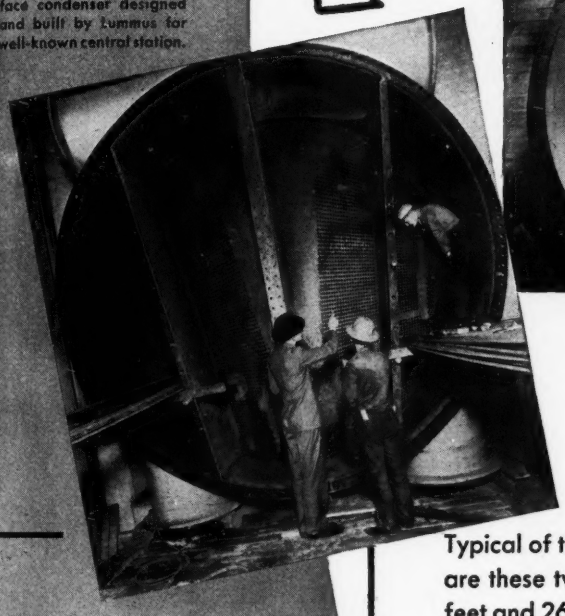
302-28-5900

NOTE THE LARGE OPEN STEAM LANES

26,500 foot Lummus surface condenser now installed in another public utility plant.



32,600 square foot surface condenser designed and built by Lummus for well-known central station.



...In these LUMMUS Surface Condensers

Typical of the efficiency and versatility of Lummus design are these two large surface condensers, 32,600 square feet and 26,500 square feet, respectively. The distinctive tube sheet layouts . . . while varied to meet individual conditions . . . provide large internal steam space with an open steam lane through the center of the condenser.

Lummus Surface Condensers are designed for full deaeration by cascading the condensate through live steam. This operation serves to prevent condensate depression even at low loads, as well as removing the soluble air. Lummus also designs and builds Steam Jet Air Ejectors for use with its surface condensers, thus eliminating divided responsibility for the proper operation of the complete plant. Further data upon request.

Lummus Power Plant Equipment

- Surface Condensers
- Steam Jet Air Ejectors
- Bleeder Heaters
- Boiler Blowdown Heat Exchangers
- Evaporators
- Fuel Oil Heaters
- Lubricating Oil Coolers

THE LUMMUS COMPANY • 420 LEXINGTON AVE., NEW YORK 17, N. Y.

LUMMUS

Progress and Power in the E

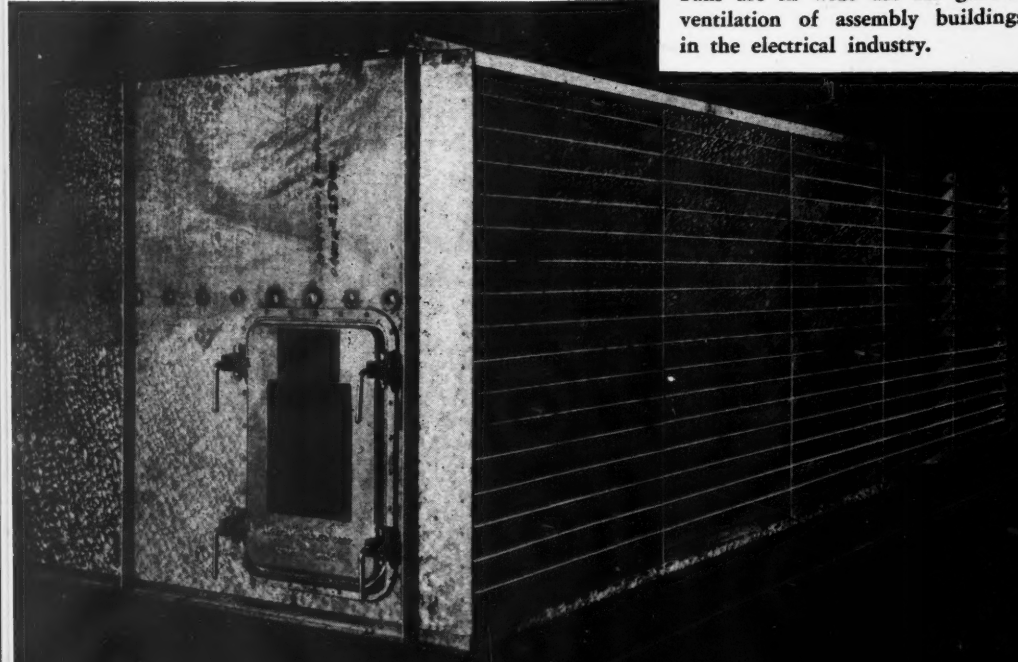
The electrical manufacturing industry, which furnishes the equipment, and the Public Utilities which furnish the power, are in a large measure responsible for much of the progress in the America of today. It has been a privilege of American Blower to work with both of these great industries, furnishing mechanical draft equipment, fans, dust collectors and fluid drives.

AMERICAN BLOWER

ARMY E NAVY
For Production
"Well Done"

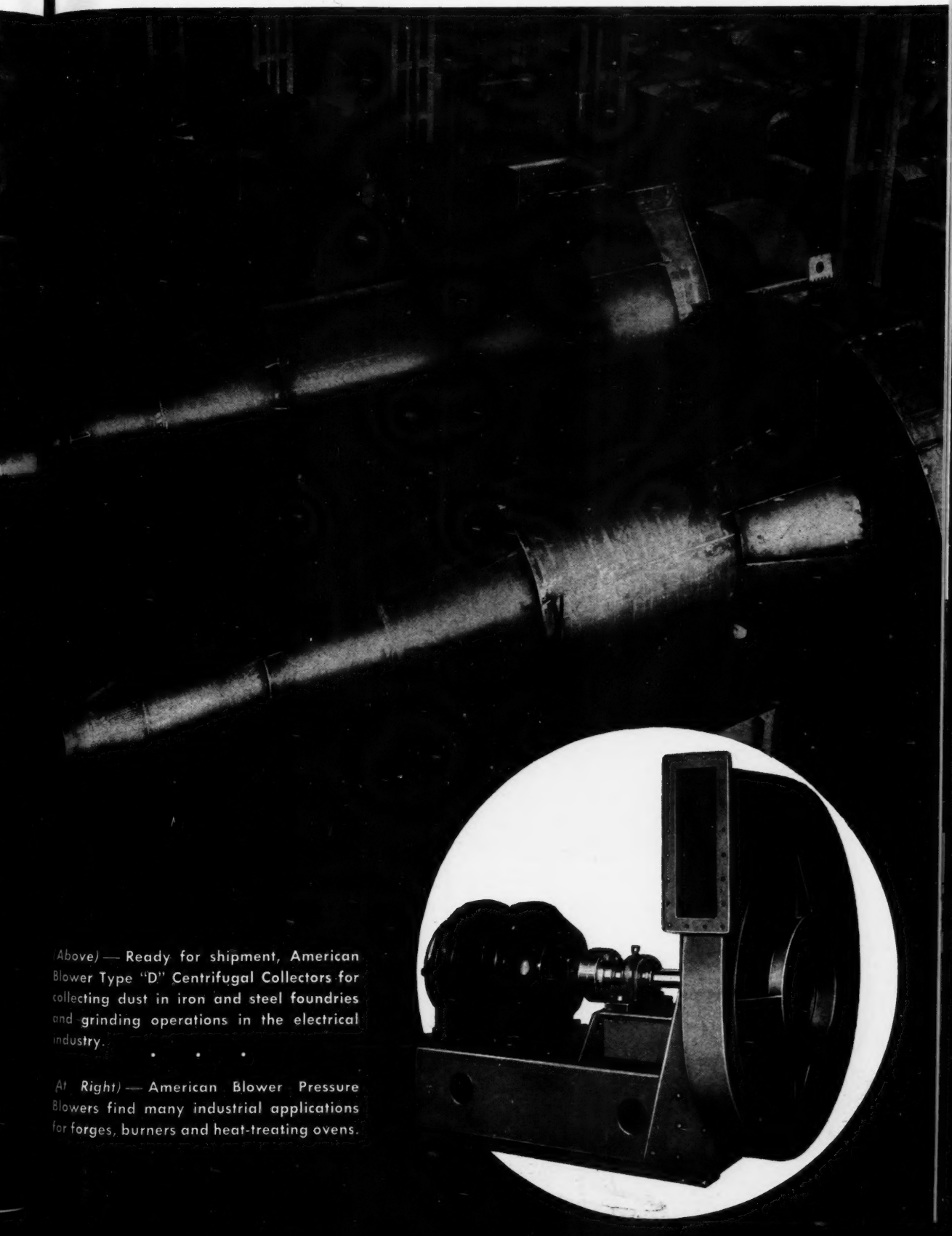
AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation

American Blower Air Supply Fans are in wide use for general ventilation of assembly buildings in the electrical industry.



American Blower equipment for washing and purifying air in process work and in finishing rooms in the electrical industry.

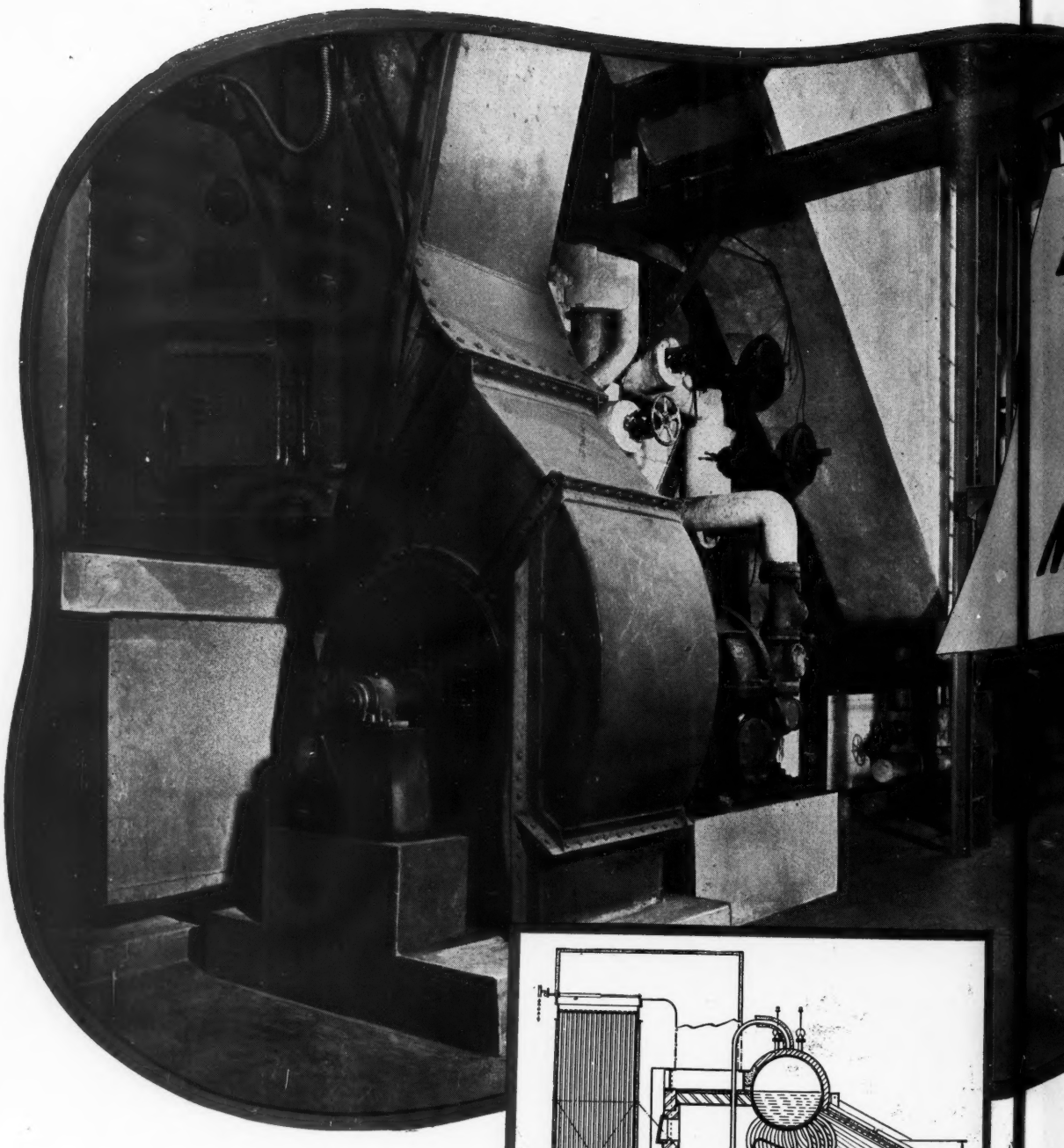
the ELECTRICAL INDUSTRY

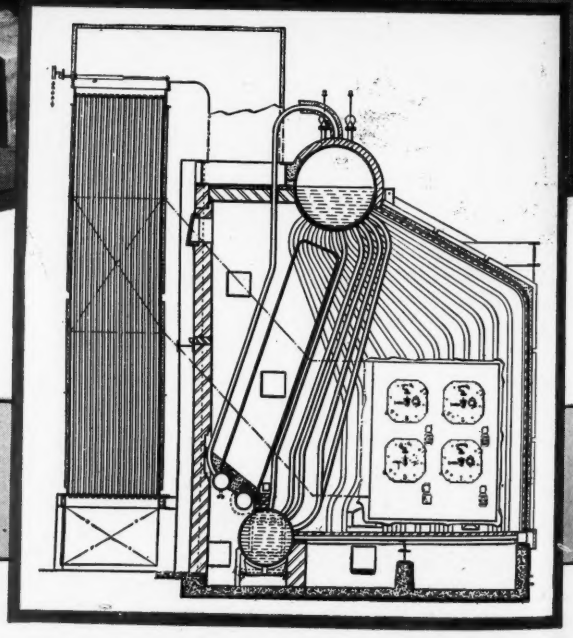


(Above) — Ready for shipment, American Blower Type "D" Centrifugal Collectors for collecting dust in iron and steel foundries and grinding operations in the electrical industry.

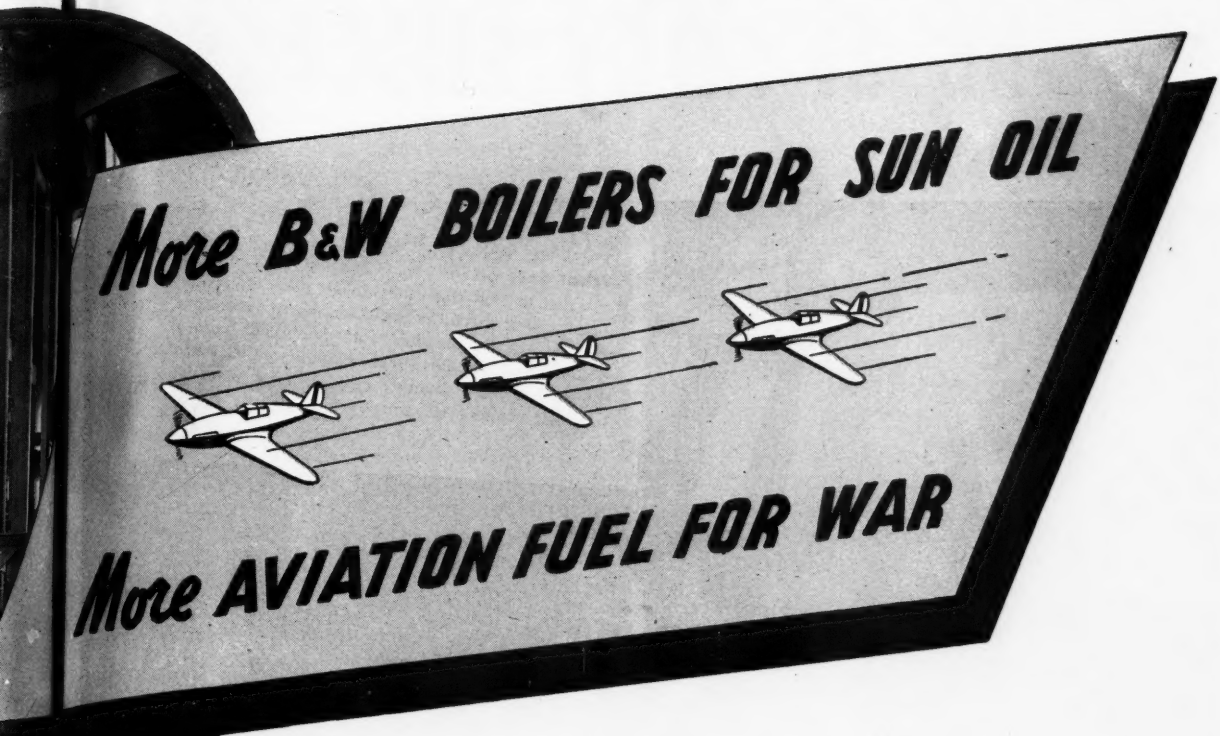
• • •

(At Right) — American Blower Pressure Blowers find many industrial applications for forges, burners and heat-treating ovens.





The Integral-Furnace Boilers have a capacity of 75,000 lb. steam per hr. each at 500 Psi and 750 F. They are fired with oil and gas.



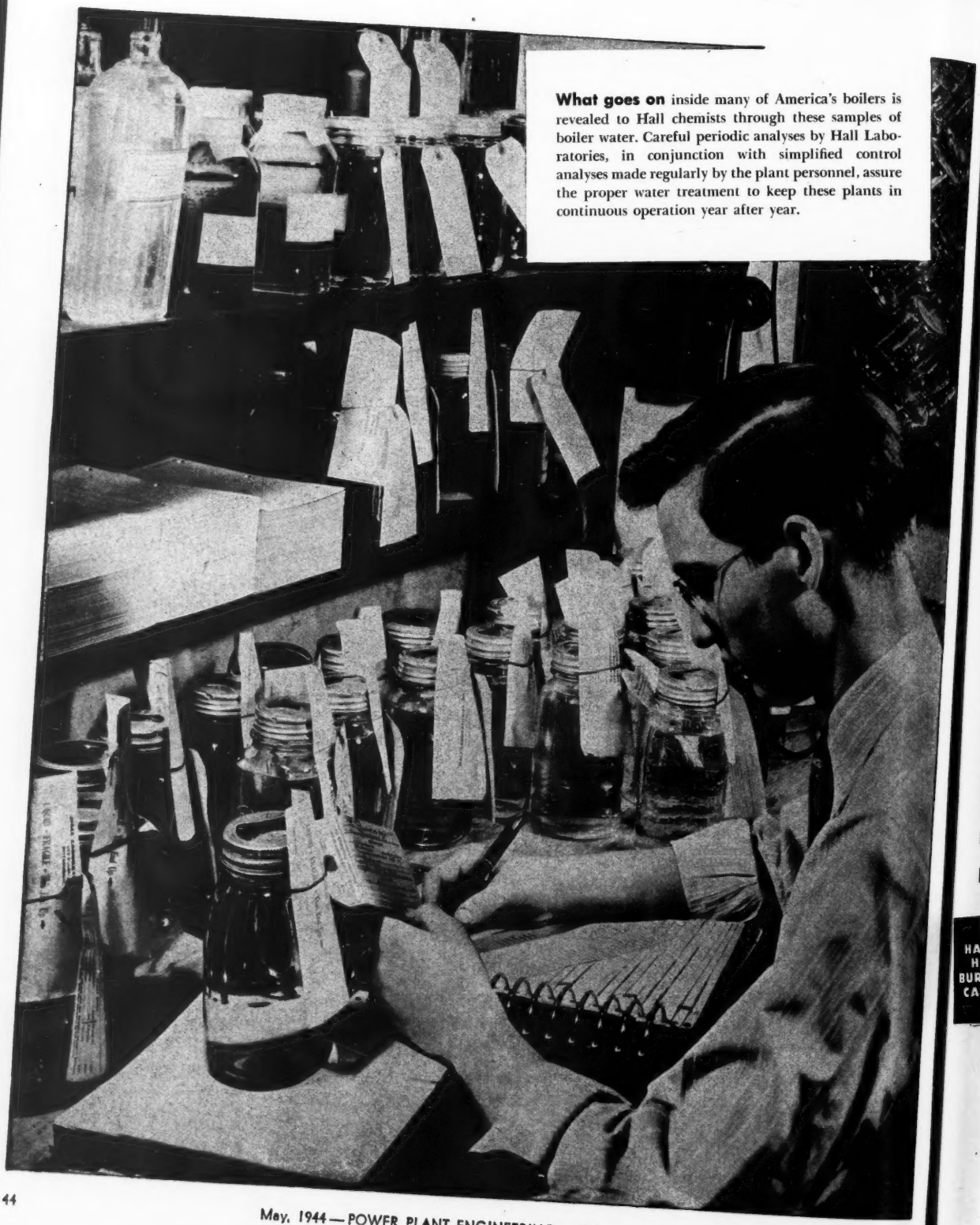
Record, war-shortening production of 100-octane aviation gasoline is expected of Sun Oil Company's new Marcus Hook refinery — one of the world's larger plants. Naturally, uninterrupted output of this vital ingredient of victory, calls for a dependable supply of power and process steam. In order to assure such a supply, three B&W Integral-Furnace Boilers were installed.

Experience with a similar B&W boiler installation at another Sun Oil boiler room at Marcus Hook since 1939 clearly demonstrated the reliability of the B&W Integral-Furnace Boiler for these new requirements. Further evidence of Sun Oil's confidence in these boilers is the fact that a fourth unit of the same type will be later added to the present Marcus Hook installation.

BABCOCK & WILCOX

THE BABCOCK & WILCOX COMPANY
85 LIBERTY STREET NEW YORK 6, N. Y. G-265T

Why successful



What goes on inside many of America's boilers is revealed to Hall chemists through these samples of boiler water. Careful periodic analyses by Hall Laboratories, in conjunction with simplified control analyses made regularly by the plant personnel, assure the proper water treatment to keep these plants in continuous operation year after year.

boiler operation is an *"inside job!"*

PROGRESS began in water conditioning service when a group of Hall chemists started the research into what goes on *inside* a boiler. At that time power plant operators were at the mercy of scale, corrosion, carryover and embrittlement.

To this simple, and now clearly obvious approach to the problems of boiler water conditioning, which Hall Laboratories follow as vigorously today as they did twenty years ago, the entire steam power world is indebted. One by one the mysteries surrounding the effects of steam under high pressures and high temperatures have been solved. On learning the causes the road was cleared for finding the remedies.

Out of this knowledge and experience has come the best system ever devised for keeping a boiler out of trouble arising from water—THE HALL SYSTEM OF PREVENTIVE CARE. Operated within your own plant, by your own personnel under direct Hall field supervision, it effectively eliminates unscheduled outages which owe their origin to scale, corrosion, embrittlement and carryover.

Today, in many of the country's leading power plants, Hall preventive care is as much a part of their operating system as the very boilers in which it is employed. The reason is plain. It brings results. They have the comforting assurance that behind it is the world's most authoritative source for the solution of water conditioning problems.

You can probably remember the time when the only clean boiler was a new one. Today, through Hall preventive care, countless veteran boilers are contributing mightily to war production. May we give you further facts about this service?

HALL LABORATORIES, INC., Hagan Building, Pittsburgh 30, Pa.
A Subsidiary of Hagan Corporation

Water samples are accurately checked to see that oil content is being kept to an absolute minimum.

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM *of Boiler Water Conditioning*

Hall Service in a Nutshell

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

1. **Minimizes boiler outages caused by water**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

[PUMP TIPS FROM ALLIS-CHALMERS — ONE IN A SERIES]

How to make BEARINGS Last Longer . . .

ONE OF THE MAIN CAUSES of bearing trouble is misalignment. For when pump and its driving motor are not correctly aligned, every revolution of the shaft throws tremendous extra load on all moving parts within the pump's closely fitted body — resulting in greatly accelerated wear, oftentimes in complete bearing failure.

In an effort to eliminate the misalignment factor, A-C developed, for many applications, the "Electrifugal" pump — in which both motor and pump impeller are mounted on one shaft and in one frame. This *unit-design* prevents shaft from getting out of line . . . minimizes possibility of excessive bearing wear.

However, many pumps in use today are coupled to *separate* driving motors. In guarding against misalignment in this type pump, see that coupling flanges are perfectly aligned — and that they're kept that way!

Allis-Chalmers "Electrifugal" Pumps are equipped with two large ball bearings which support *both* the rotor and runner on one shaft.

Regardless of whether your pumps are equipped with ball, roller or sleeve bearings, here are a few maintenance tips that can prove useful to you in getting longer life out of bearings:

▶ Although too much oil won't harm sleeve bearings, too much grease in anti-friction type bearings will *promote* friction and heat. Main job of grease in anti-friction bearings is to protect steel elements against corrosion, not friction.

▶ No one rule on lubrication frequency fits all pump installations. So play safe: if anything, change lubricant *before* it's too worn or too dirty.

▶ Once a month, check bearing temperatures with a thermometer . . . *not by hand.*

▶ In the case of sleeve bearings, measure bearings for wear every three months, replacing them if wear is excessive. Generally allow two-thousandths of an inch clearance — plus one-thousandth of an inch for each inch of shaft journal diameter.

▶ Every three months, drain lubricant, washing out oil wells and bearings with kerosene. In the case of sleeve bearings, check to see that oil rings are free to turn with the shaft.

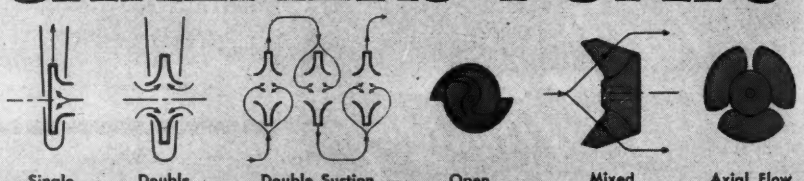
▶ If you haven't done so already, send for Allis-Chalmers' *free* "Handbook for Wartime Care of Centrifugal Pumps". Applies to *all* makes of pumps; contains *no* advertising. Contents include: valuable tables of friction losses; handy guide to locating trouble; wartime maintenance schedule. Address your request to ALLIS-CHALMERS MFG. CO., MILWAUKEE 1, WIS.

A 1709

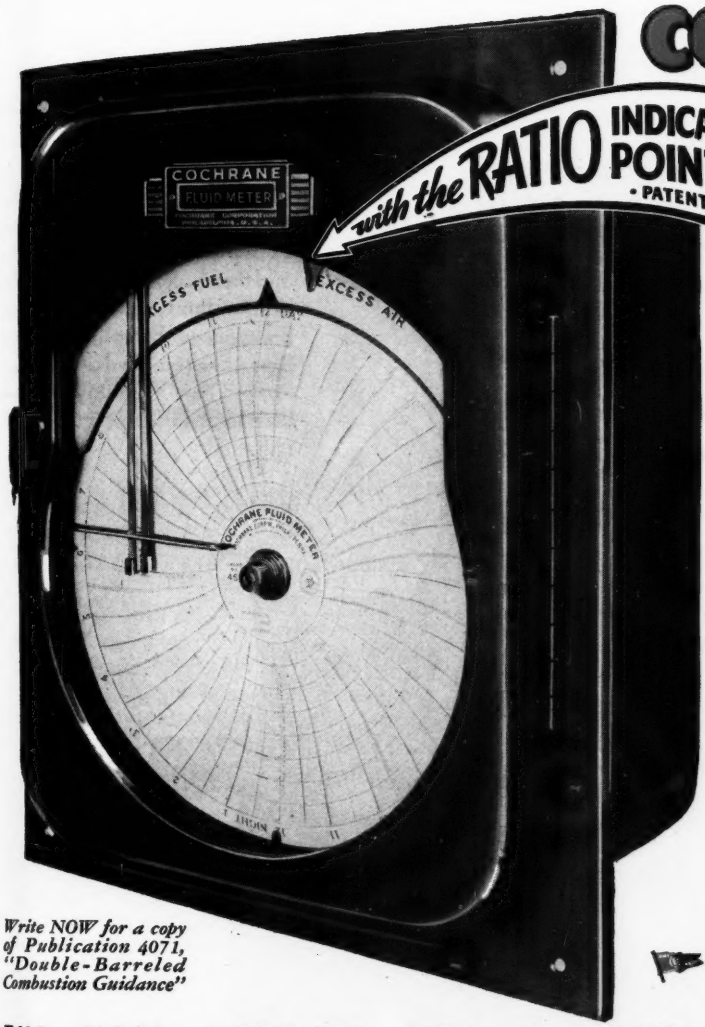
♪ *Tune in the Boston Symphony, Blue Network, every Saturday at 8:30 pm, EWT.*

ALLIS-CHALMERS PUMPS

Allis-Chalmers builds all types and variations of pumps shown at right. Capacities from 10 to 150,000 gpm—heads to 2500 lbs.



New! A BOILER RATIO METER by COCHRANE



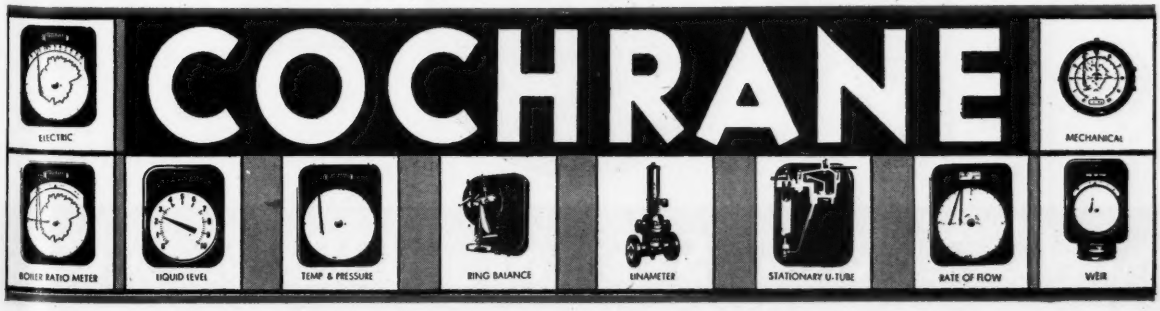
A Red indication pointer operating across a white 10" scale makes it unnecessary to examine closely the position of the pens to determine whether the air is excessive or insufficient, for the movement of the pointer is 3 times as great as the difference between the pens.

THE Cochrane Corporation offers to the power plant field a new boiler meter of the steam-flow, air-flow type known as the Cochrane Boiler Ratio Meter. This meter has several important advantages over other constructions. An easily adjustable cam in the air flow mechanism permits the operator to establish the relation of air supply to fuel supply (measured by steam generated) most favorable for his particular operation. The ratio indicating pointer, illustrated and described above, is another feature. The steam flow mechanism is the well-known Cochrane Friction-Free Electric Flow Meter, operating on the null balance principle assuring highest accuracy, while the air flow mechanism is based on the highly responsive Hays slack diaphragm, equipped with an electric motor follow-up for ample power. Intelligent use of the Cochrane Boiler Ratio Meter will result in lower operation and maintenance costs as well as greater plant capacity without increasing the size of the steam producing units or auxiliaries.

Write NOW for a copy of Publication 4071, "Double-Barreled Combustion Guidance"

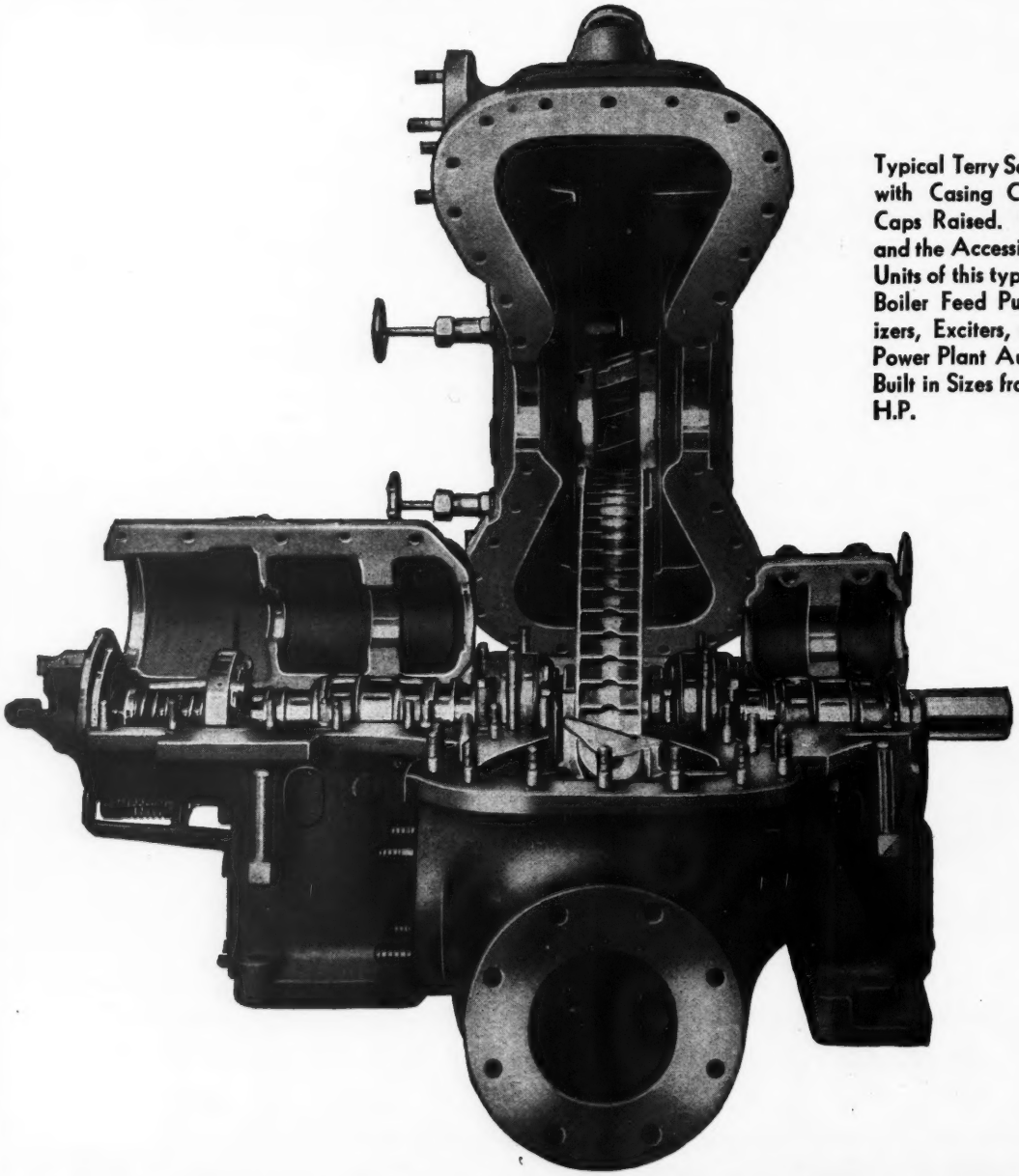
COCHRANE CORPORATION
3123 N. 17th St., PHILADELPHIA 32, PA.

THE MOST COMPLETE LINE OF FLOW MEASURING INSTRUMENTS



The TERRY

FOR AUXILIARY DRIVE



Typical Terry Solid Wheel Turbine with Casing Cover and Bearing Caps Raised. Note Ruggedness and the Accessibility of All Parts. Units of this type are used to drive Boiler Feed Pumps, Coal Pulverizers, Exciters, and All Types of Power Plant Auxiliary Equipment Built in Sizes from 5 H.P. to 2000 H.P.

THE TERRY STEAM TURBINE CO.

Wheel Turbine

E OFFERS MANY ADVANTAGES

FROM THE SMALLEST TO THE LARGEST, THESE RELIABLE TURBINES HAVE —

- Indestructible One Piece Wheel
- Large Radial and Axial Clearances
- Double Rim Protected Blading
- Dependable and Durable Governor
- Heavy Dust-Proof Bearing and Governor Housing
- Independent Overspeed Trip with Separate Valve
- Sturdy Casing Design
- Strong and Easily Inspected Steam Strainer
- Sight Oil Level Gauges
- Individual Nozzle Control
- Truly Accessible Construction, Which Makes Inspection of the Interior Parts a Simple Matter

Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

For Full Details ask for Bulletin S-116

TERRY SQUARE - HARTFORD, CONN.

DESIGNED ESPECIALLY for HIGH-SPEED CENTRIFUGAL PUMPS!

JOHNS-MANVILLE SPIRAL PLASTIC PACKING

HERE'S a tough pliable spiral plastic packing that's proven unusually successful in high-speed centrifugal pumps. It provides a tight-sealing bushing that operates with low friction.

Johns-Manville Spiral Plastic Packings are made of selected asbestos fiber combined with such materials as non-friction metal, graphite, mica, lubricants, and binding compounds. These materials are thoroughly mixed together into a homogeneous composition and formed into spirals of the proper density and uniform cross-section by extrusion through steel dies. Spiral Plastic comes in sizes of ¼" and up, any of which can be used for cutting rings to fit rods of various diameters.

A number of styles of J-M Spiral Plastic Packings are available, each designed for a particular use, such as No. 620 for oil, Nos. 640 and 645 for acid, No. 630 for food and Nos. 610 and 615 for general service. For more facts, write Johns-Manville at 22 East 40th Street, New York 16, N. Y.

Advantages of J-M Spiral Plastic Packing:

Easy installation **Low friction**
Uniform density and cross-section
Each style compounded for a specific service
Eliminates need to stock many sizes of rings

JM PRODUCTS

Johns-Manville PACKINGS & GASKETS

THERE'S A J-M DISTRIBUTOR NEAR YOU

Sectional header... CROSS-DRUM BOILER

...meets wide range of local conditions

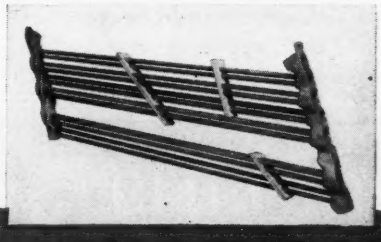
THE sectional header, cross drum boiler, as designed and built by Springfield is widely favored for manufacturing plants as well as central station use.

One reason for this is that the Springfield variation of this type of boiler is flexible enough to be economically adapted to a wide range of fuels, water, space, load, and other local conditions.

Operating reports, on a wide range of fuels, show that Springfield units develop unusually high efficiencies as proved by low exit gas temperatures; through using smaller tubes, staggered tube groupings, permanently tight baffle construction, and well integrated overall design.

"Less outage for maintenance" is a common comment on Springfield installations. Controlled circulation with delivery to the steam drum above the water level gives this boiler ability to produce dry steam and handle rapidly changing loads. Water conditions should be carefully controlled in any modern boiler plant but this type of boiler is less sensitive and affords additional protection when water conditioning "slips". Larger and fewer handhole openings reduce the time and cost of cleaning, inspection and repair. Soot and ash cannot lodge on headers and drums. All parts are readily accessible.

In replacing obsolete boilers, it is often desirable to install larger capacity units without extensive building changes. Springfield boilers are lighter and more compact than other designs, and are readily adaptable to restricted space requirements. Pitch of tubes may be varied from 15 to 25 degrees to suit local conditions. High capacity water walls increase furnace capacities.



Because of factory assembled sections and single drum construction, from 30 to 60 days are saved on erection time. Less brickwork is required, and cross tube baffles are delivered in place. Complete drawings and patterns are available to produce duplicate units of many of the great number of modern Springfield generating plants built in recent years.

★ ★ ★

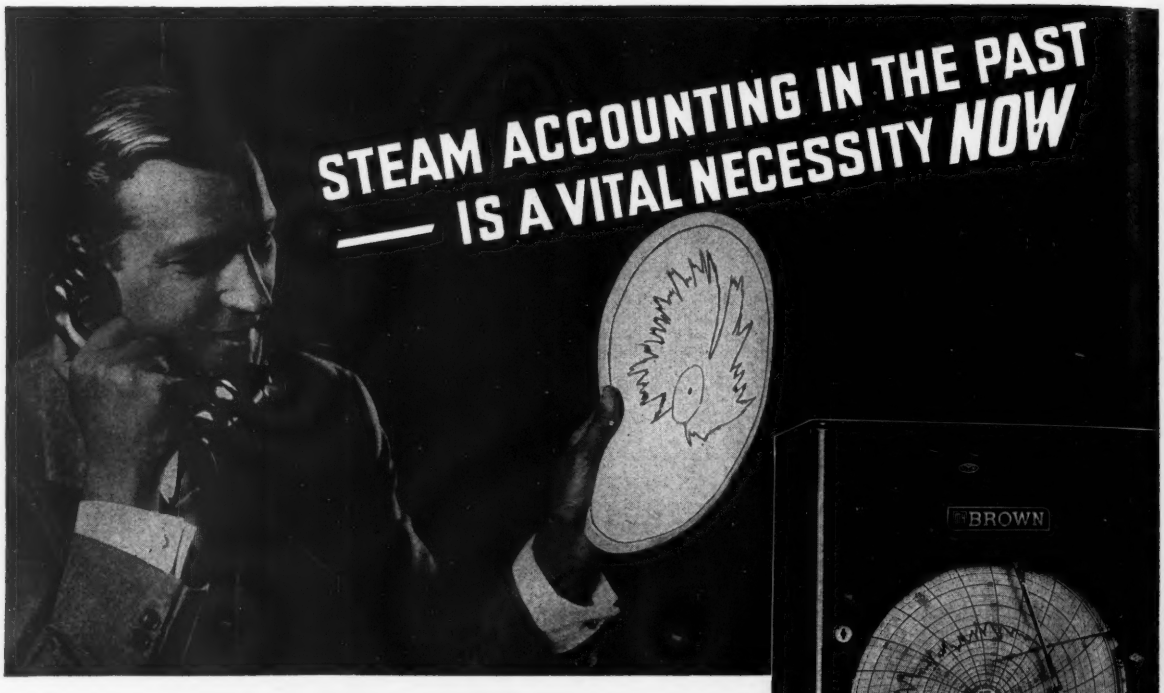
Springfield boiler installations range from 5,000 to 450,000 lbs. per hour capacity; and from 75 to 750 psi pressure. Contracts taken for complete steam generating units. Write for information. **SPRINGFIELD BOILER CO., 1953 E. Capitol Ave., Springfield, Ill.**

SPRINGFIELD

STEAM GENERATING UNITS

SPRINGFIELD BOILERS

ANY SIZE
ANY FUEL
ANY PRESSURE



Conservation of fuel through steam accounting is a vital necessity in power plant operation. Wasted steam represents not only a waste of production and resources, but of man-hours and money.

With Brown Electric Flow Meters measuring the flow of fluids for power, heating and processing, you are completely protected —because the Brown Recording Planimeter Pen "A" making the marginal record shown on the chart pictured supplies the proof that a definite number of pounds of steam, gallons of water, cubic feet of gas or barrels of oil were delivered, utilized or wasted.

This outstanding feature of Brown Electric Flow Meters is of the greatest value in cost accounting of steam production and distribution.

In addition, Brown Electric Flow Meters enable the operators to maintain the most efficient boiler operation—thus effecting substantial fuel savings.

For details, write for Catalog 2008. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Company,* 4491 Wayne Avenue, Philadelphia 44, Pennsylvania. Offices in all principal cities. 119 Peter Street, Toronto, Canada—Wadsworth Road, Perivale, Middlesex, England—Nybrokajen 7, Stockholm, Sweden.

Automatic planimeter pen record "A" shows steam flow in volume units. Record line "B" shows rate of flow.

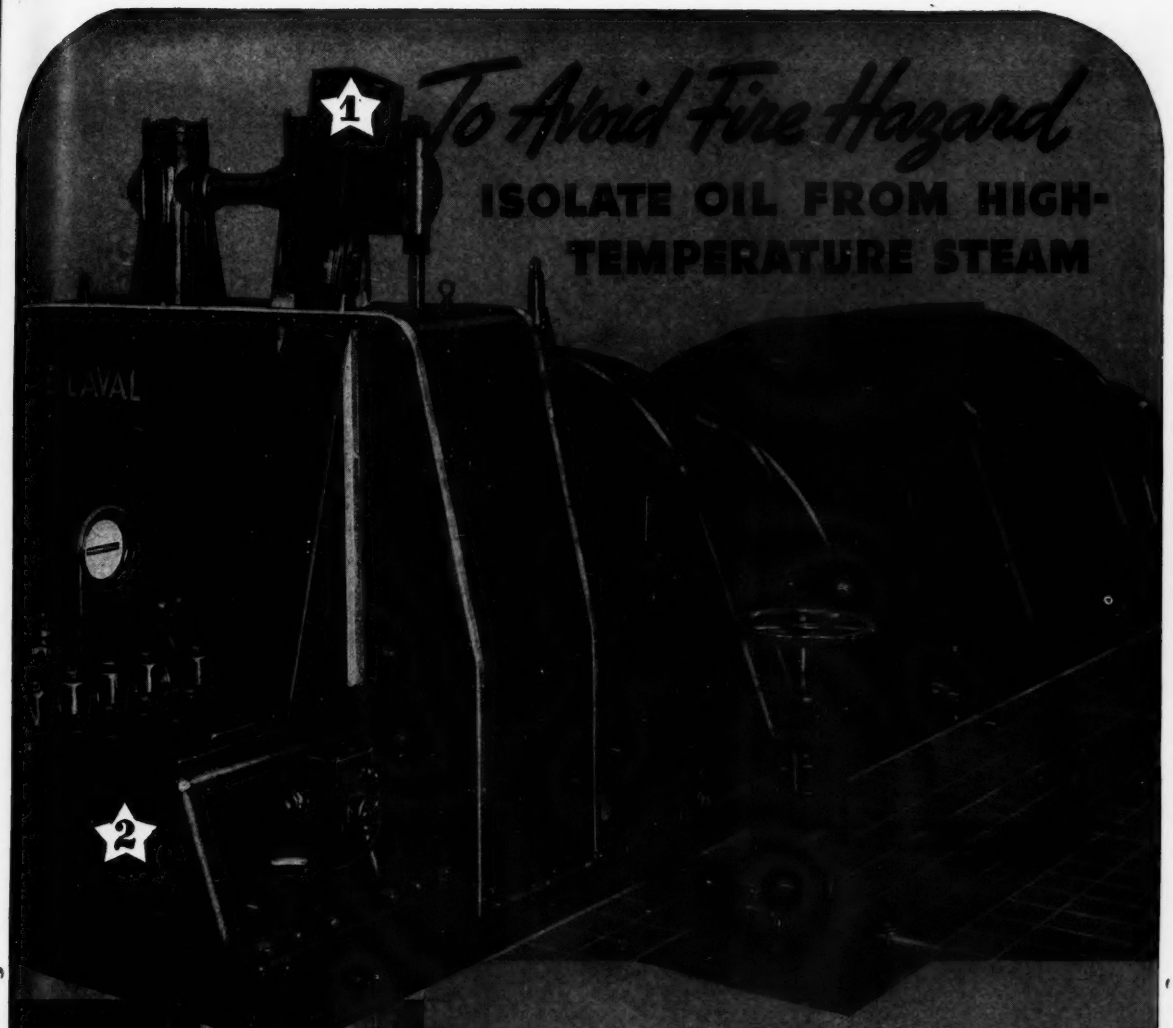
BROWN FLOW METERS

. . . MINNEAPOLIS - HONEYWELL CONTROL SYSTEMS . . .

To Measure and Control is to Economize

To Avoid Fire Hazard

ISOLATE OIL FROM HIGH-TEMPERATURE STEAM



IN this De Laval multistage turbine power is transmitted mechanically to the valve-lifting gear 1 at the top of the casing from a pilot-controlled hydraulic cylinder in the sub-base, 2 which also encloses the speed governor, accumulator and relief valve, and other parts relating to the governor control.

The main reservoir for both lubricating and hydraulic pressure oil, the main and auxiliary oil pumps, the strainers, and the oil coolers are located on a platform 3 below the sub-base.

No oil cylinders or oil piping are over the steam chest or the steam piping, thus keeping oil away from high-temperature steam.

Other requirements of high-pressure, high-temperature steam have been met by the use of special alloys and improved design throughout.

Ask for Publication 1-3527

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF TURBINES · STEAM HYDRAULIC PUMPS · CENTRIFUGAL IMPELLER ROTARY DISPLACEMENT · MOTOR MOUNTED · MIXED FLOW · CLOGLESS · SELF PRIMING CENTRIFUGAL BLOWERS and COMPRESSORS · GEARS · WORM, HELICAL and FLEXIBLE COUPLINGS

NO TIME OUT
on the way to Murmansk

When you're beating your way up through the Arctic, you can't lay-to for repairs to equipment. Everything...from winches to evaporators to bilge pumps...must work smoothly regardless of the pounding it gets from heavy seas and high speed operation.

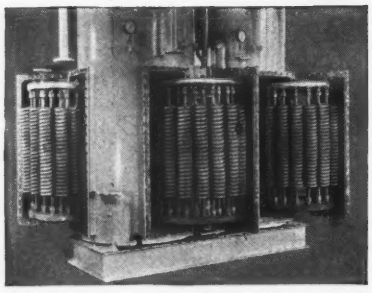
Packing, for instance, must not blow or squeeze out in service.

Genuine U.S. Rainbow Sheet Packing is specially designed for packing flanges and other parallel surfaces against hot or cold water, air, saturated steam pressures up to 150 pounds and hydraulic conditions.

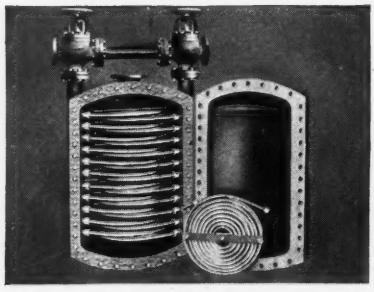
It is of the proper body to make a tight joint...sufficiently pliable to fill up any irregularities in the flange and has the necessary resilience to overcome normal vibration, expansion and contraction in a line...*it is dependable under all recommended operating conditions.*

RAINBOW *SHEET PACKING*

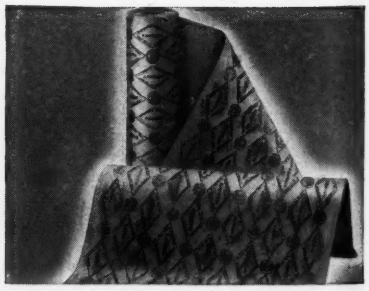
SERVING THROUGH SCIENCE



FRESH WATER FROM SALT—both for drinking and boiler make-up is obtained by means of special distillation equipment on Liberty Ships, fighting craft and huge floating drydocks. U.S. Rainbow Sheet Packing is used.



CHOSEN FOR DEPENDABILITY. The manufacturer of this feed water heater makes many other types of marine equipment. To be 100% sure of packing dependability and trouble-free operation, he uses U.S. Rainbow Sheet Packing exclusively.



EASY TO IDENTIFY. Genuine U.S. Rainbow Sheet Packing is easily identified by its familiar trade mark, eleven rows of black diamonds running lengthwise the sheet and separated by the U.S. Rubber Company Seal.

Listen to the Philharmonic-Symphony program over the CBS network Sunday afternoon, 3:00 to 4:30 E.W.T. Carl Van Doren and a guest star present an interlude of historical significance.

UNITED STATES RUBBER COMPANY

1230 SIXTH AVENUE • ROCKEFELLER CENTER • NEW YORK 20, N. Y.

15 HENDY FEATURES

In the turbine—

1. Economical water rate per kwh.
2. Rigid spindles with discs having large hub sections form the backbone of the turbine structure and assure greater strength.
3. Step cut labyrinth diaphragm seals.
4. Steel Rateau nozzle discs with welded-in, rolled stainless steel nozzle blades and spacers.
5. Governing system that uses anti-friction bearings and is without stuffing boxes or soft packing.
6. Smooth, compact design without sacrifice of accessibility.

In the reduction gear—

7. Fabricated steel gear case, smoothly finished — no sharp corners or edges.
8. Rigidity combined with light weight.
9. External piping reduced to a minimum.

In the generator—

10. Rolled steel-plate field yoke of split type with halves bolted together.
11. Shock-proof, solid construction, giving greatest safety under adverse conditions.
12. Liberally dimensioned, providing capacity for emergency overloads.
13. High efficiency through careful design.
14. Self-aligning sleeve type bearing mounted in spherical seat insuring simple alignment of shaft.
15. Sixty-six years of generator building experience.

EST. 1858

BRANCH OFFICES:

New.. POWER for a more electrified America

Built to the rigid requirements of U.S. Navy and Maritime Commission specifications for war service today, this Hendy Turbo-generator plant forecasts the standards for postwar electric generating equipment.

In developing its rugged, compact design, Hendy engineers swept the boards of old ideas—the result is a unit of sound reliability and long service life.

Construction features normally found only in larger turbo-generators are in these new Hendy power plants. These features insure larger factors of strength and safety, more economical operation and higher over-all efficiency.

Hendy turbo-generating plants are designed in a range of 250 to 750 kw permitting their use in a wide variety of marine and industrial service. Submission of your specification requirements is invited.

JOSHUA HENDY Division

JOSHUA HENDY IRON WORKS

SUNNYVALE, CALIFORNIA

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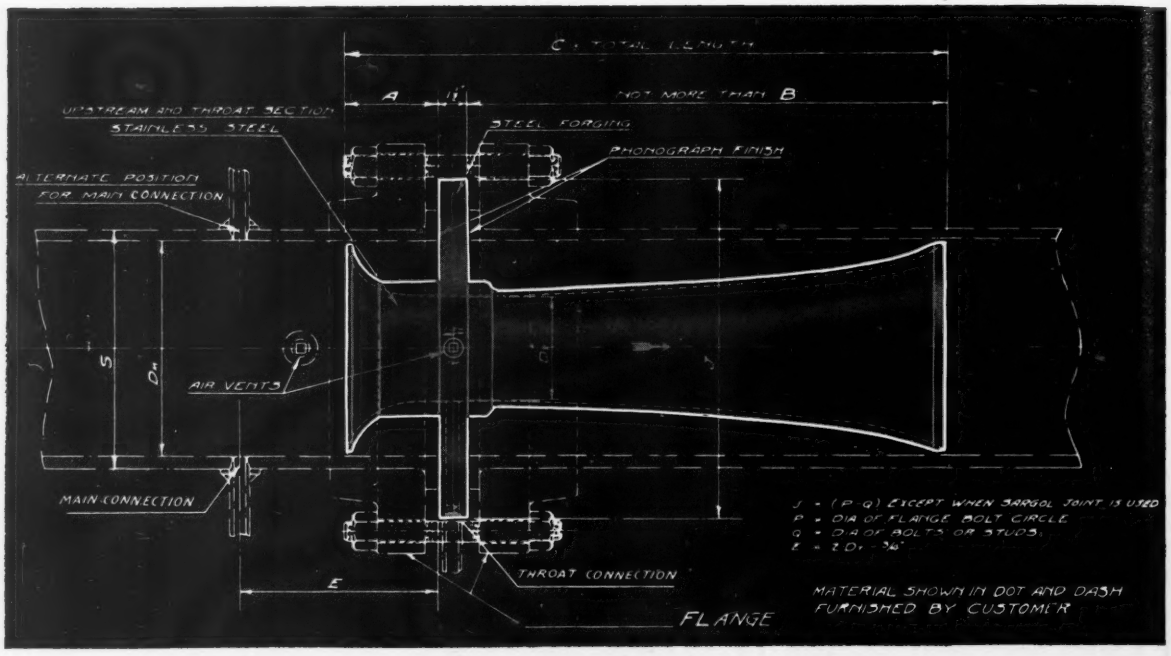
TURBO-GENERATORS

REDUCTION GEARS

STEAM TURBINES

DIESEL ENGINES

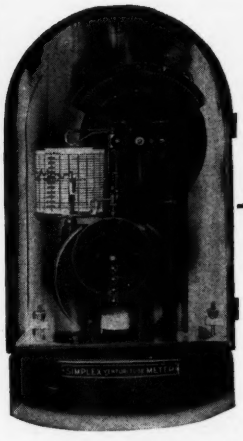

C = TOTAL LENGTH
A
NOT MORE THAN B
UPSTREAM AND THROAT SECTION STAINLESS STEEL
STEEL FORGING
PHOTOGRAPH FINISH
ALTERNATE POSITION FOR MAIN CONNECTION
AIR VENTS
MAIN CONNECTION
THROAT CONNECTION
FLANGE
E
J = (P - Q) EXCEPT WHEN GARGOL JOINT IS USED
P = DIA OF FLANGE BOLT CIRCLE
Q = DIA OF BOLTS OR STUDS
E = 2 D - 3/8"
MATERIAL SHOWN IN DOT AND DASH FURNISHED BY CUSTOMER

SIMPLEX INSERT VENTURI TUBE (TYPE "TG")

with MO Flow Rate Meter

INSTALLED IN EXISTING LINES... PROVIDES STANDARD VENTURI HEAD QUANTITY

Simplex "TG" Tubes are easily inserted in pipe lines of 3" diameter and up, and provide a convenient, accurate means of establishing differential head characteristics which are as dependable as those obtained from standard Venturi Tubes, with a loss of head considerably lower than in orifice plates. For high or low pressure lines any required material may be used such as steel, bronze, stainless steel, cast iron, etc. The flange can be furnished to fit any type of pipe joint or welding ring. The cost of a "TG" Tube is relatively low.



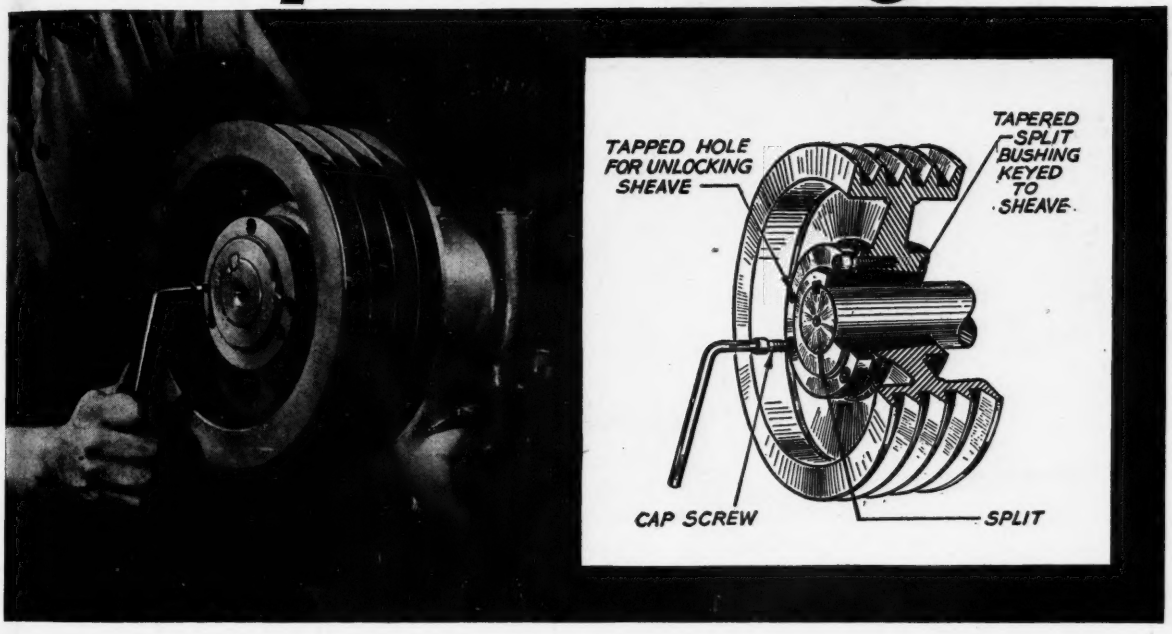
THE SIMPLEX MO METER

Simplex "TG" tubes in combination with MO Meters (indicating, recording, totalizing) are widely used for the accurate flow rate measurement of water, oil, gases, air, and industrial liquids. Many power and industrial plants measure fluids of all types with this simple, efficient, primary device and meter, which converts differential pressure heads into rates of flow.

Write today for further information and details of installation of Simplex "TG" Insert Venturi Tubes.

SIMPLEX VALVE & METER COMPANY
6783 UPLAND STREET, PHILADELPHIA 42, PA.

It's Smoother Running because it "Grips like Magic!"



...And it's the fastest mounting sheave on the market—goes on with one easy locking operation—saving man-hours and money.

POSITIVE clamp fit of Allis-Chalmers' great new "Magic-Grip" sheave means shafts are gripped tightly and uniformly...eliminating wobble and shear!

Its tapered split bushing makes it possible for anyone to mount or remove sheave quickly and easily — an important worker-safety feature. Accommodating normal shaft tolerances, the sheave that "grips like magic" may be changed often without injury to shaft.

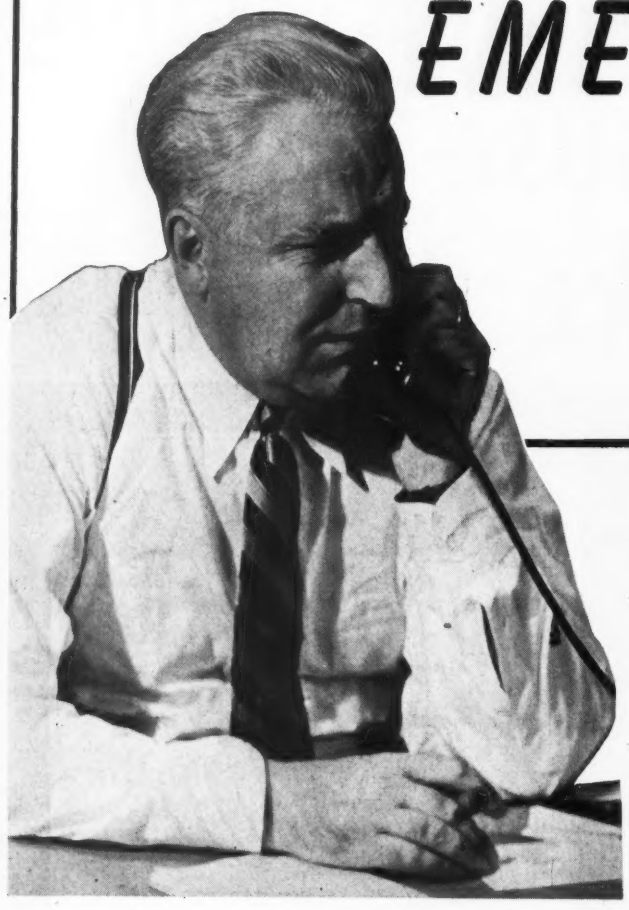
And you get the great new "Magic-Grip" sheave... *at no increase in price!* Now, more than ever, it pays to make Allis-Chalmers your "V-Belt Headquarters."

For complete information, ask our nearest district office or Texrope dealer for Bulletin B6310. Or write ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1681

Allis-Chalmers Texrope

"MAGIC-GRIP" SHEAVES

EMERGENCY Is Our NORM



Hurry calls are often our summons. At all hours of day and night, phone calls and telegrams come in requesting emergency service on all types and makes of condensers.

You can depend on us in emergencies. Our crews are ready for breakdown correction, and arrive equipped to do the job. No surveying the situation, sending back for tools or equipment, or other useless maneuvers. Instead, our crews know their business, have what it takes, and proceed directly to remedy the trouble and get your units back in service.

These are emergency times—so, when you have condenser emergencies, call Conseco.

It is better, of course, to avoid breakdowns by having condensers inspected when your boilers are shut-down in regular course.

Condenser tube failure can be forestalled by hydrodynamic testing of tubes and replacing those that blow under test.

Condenser Service AND ENGINEERING CO., INC.

83 RIVER STREET, HOBOKEN, NEW JERSEY

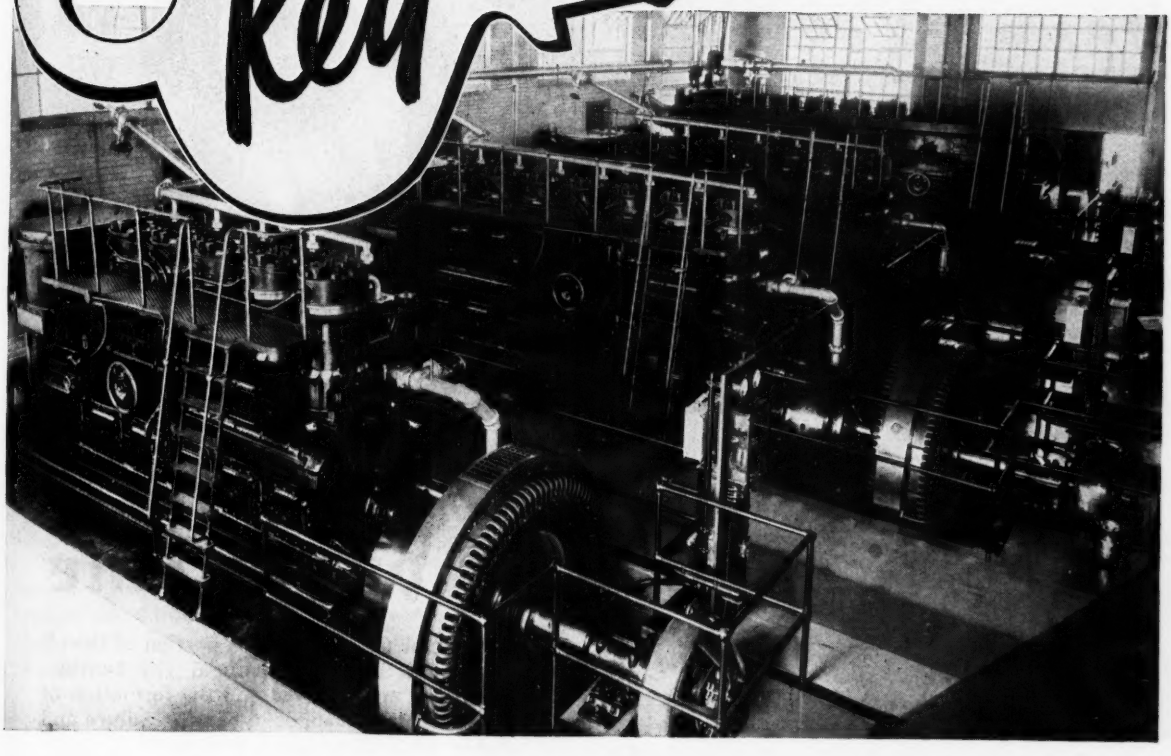
★

NEW JERSEY TELEPHONE—HOBOKEN 3-4425

NEW YORK TELEPHONE—RECTOR 2-9360 **AFTER 6 P. M. AND SUNDAYS—HOBOKEN 3-4428**

5-CS-1

A Key to BETTER MAINTENANCE



Continuous operation, excessive wear, and today's replacement difficulties demand *better maintenance* of power units.

A key to better maintenance is *better lubrication.*

Sinclair Rubilene Oils are specially designed for better lubrication of *DIESEL ENGINES.* Rubilene seals compression . . . reduces ring wear . . . provides *safe* lubrication under continuous heavy loads.

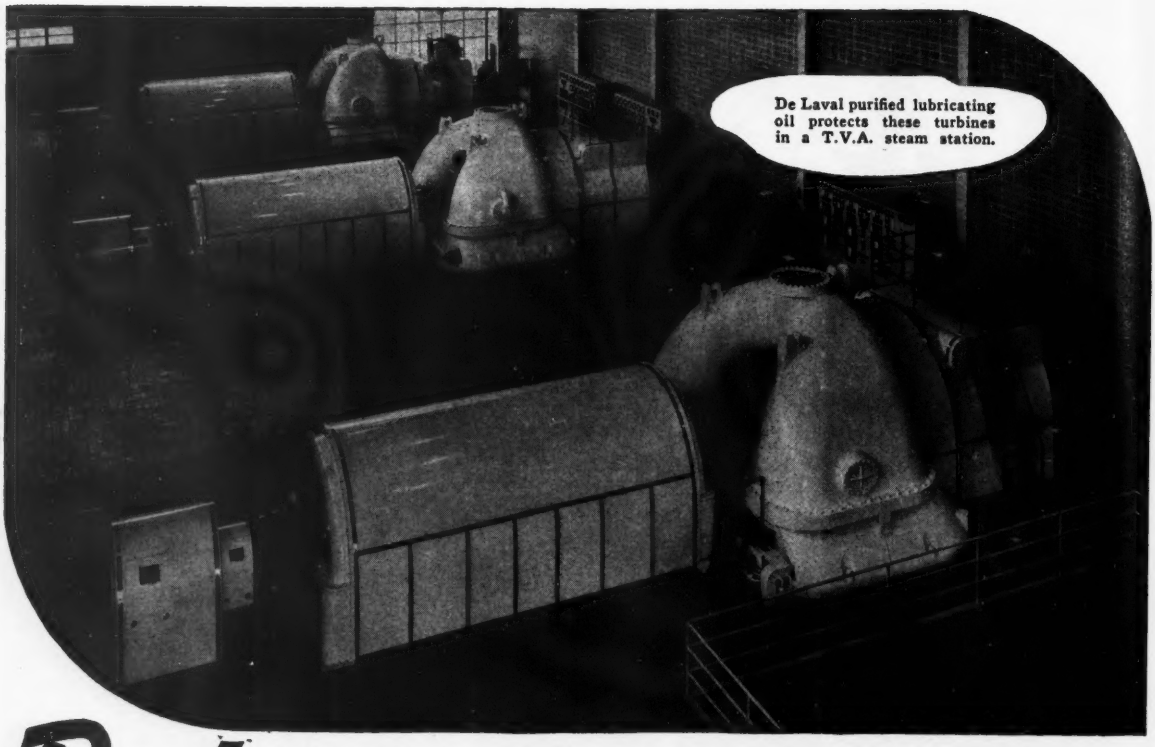
Rubilene non-gumming, sludge-resistant qualities afford lengthened operating periods between overhauls.

Where prolonged heavy duty operation threatens severe wear on rings and cylinders, Sinclair Rubilene Oils make for *better maintenance.* Consult us about your lubrication problems.

(Write for "The Service Factor" — published periodically and devoted to the solution of lubricating problems.)

SINCLAIR INDUSTRIAL OILS

FOR FULL INFORMATION OR LUBRICATION COUNSEL WRITE SINCLAIR REFINING COMPANY (INC.), 630 FIFTH AVENUE, NEW YORK 20, N. Y



DE LAVAL PROTECTION
Helps Keep Turbines on the Line

TO the 96% of America's largest utilities that use De Laval Oil Purifiers may be added many government power projects. And whether the power plant is government-owned, a private plant or a central station, the protection afforded by De Laval Oil Purifiers against the troubles caused by dirty lubricating oil is a positive factor in making uninterrupted operation possible. Most of the larger turbines in the country already have De Laval protection—so do hundreds of smaller turbines and other prime movers.

By continuously by-passing a portion of the oil through a De Laval Centrifugal Oil Purifier, water and dirt are removed and the formation of sludge is retarded. Danger of bearing failure and of trouble with other lubricated parts is practically eliminated when the oil is thus purified.

Either by themselves or as part of the De Laval-Funk Process, these machines keep lubricating oil in a condition most nearly identical with that of new oil.

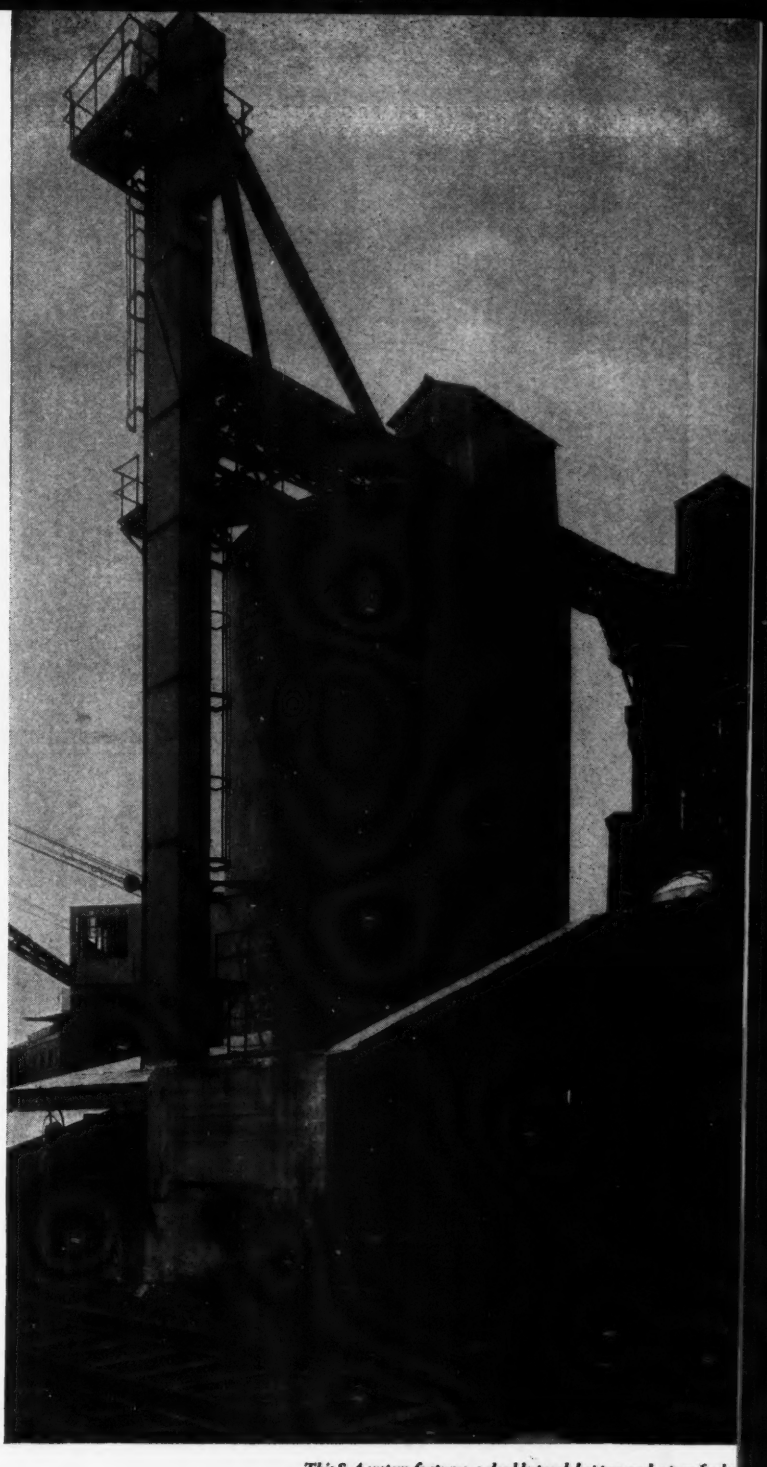
It will pay you to investigate.

★ ★ ★

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York, 6 — 427 Randolph St., Chicago, 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco, 19
THE DE LAVAL COMPANY, Limited
MONTREAL — PETERBOROUGH — WINNIPEG — VANCOUVER

DE LAVAL OIL PURIFIERS

Everywhere it's **S-A** *Specialized Engineering*



Examples of efficient Stephens-Adamson coal elevating and conveying systems are found in power plants, large and small, throughout the country.

Each installation presented individual problems which had to be solved and special conditions which had to be met before the lowest possible handling costs were assured.

Each installation was planned by S-A Engineers, long experienced in the design of efficient, economical Coal Handling systems, and put into operation by conveyors, elevators, feeders, etc., selected from S-A's complete line of manufactured handling units.

S-A recommends the *right method* and furnishes the *right equipment.*

Consult us now on your plans for improving or expanding your coal handling system.

This S-A system features a double track hopper and a pan feeder feeding coal to a double roll crusher. Bucket elevator elevates coal to 2-way discharge spout to send coal either to boiler house via belt conveyor or to storage silo for later reclaiming.

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515 RIDGEWAY AVENUE, AURORA, ILLINOIS — MFG. CO. — LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

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SIX CARS OF BLENDED AVIATION OIL

...in one-eighth the time!

This is the story of another of those it-can't-be-done jobs that helped turn the tide of battle.

Wolf's Head Oil Refining Company, Oil City, Pa., got an emergency order for six cars of Navy aviation oil, a special blend that must pass rigid laboratory tests. It was a job that would, under ordinary methods, have taken over 40 hours.

With a Bowser Proportioner, pumping directly into the tank cars, the work was finished in an elapsed time of a few minutes over *five hours*. And all tests showed perfect blending.

This Bowser Proportioner blends the many different grades of oil produced by this oil company . . . and works with almost unbelievable speed and accuracy. Speed? It blends up to 175 gallons a minute (which is in excess of the rating specified by Wolf's Head). Accuracy? Some of the proportions call for a single pint of one ingredient to 100 gallons of finished blend . . . one part in 800 . . . yet every test is "right on the nose."

That's typical Bowser Liquid Control.

Other phases of Bowser Liquid Control—oil filtration, turbine oil conditioning, force feed lubrication—are giving equally outstanding performance in public utility and industrial power plants throughout the country.

Bowser Turbine Oil Conditioners, for example, are serving in many of America's leading steel mills and paper mills throughout the country in which it is vitally important to eliminate acids which cause emulsions, corrosion and plugging of oil tubes.

Whatever type of liquid control equipment you require, here's an important point to remember —wherever you are, there's a complete Bowser service organization conveniently close to you. BOWSER, INC., Fort Wayne 5, Indiana.

THE NAME THAT MEANS **EXACT CONTROL** *OF LIQUIDS*

Move ONE unit...

QUICKLY... AT LOW COST TO NEW POSTWAR LOAD CENTERS

. . . when it's a Westinghouse CSP (Completely Self Protecting) Power Transformer

Because the Westinghouse CSP Power Transformer can be moved as a unit, it has 100% salvage value when moved to a new load center. It can be moved by truck-trailer quickly—in a matter of hours. Compare this to the time required to disassemble and move the conventional single-feeder substation. The CSP Power Transformer saves both material and man-hours . . . will cut considerably your postwar system reconversion cost.

While new postwar load centers may be unpredictable, it will pay to have substations which can be moved in to fill the gaps. The Westinghouse CSP Power Transformer performs all the functions of a single-feeder conventional substation. It is Completely Self Protecting (CSP) against lightning, short circuits, and dangerous overloads.

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Westinghouse CSP Power Transformers contain in ONE UNIT:

- transformer
- circuit breaker
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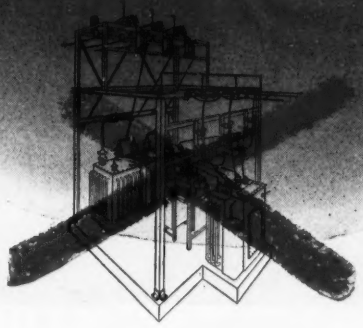

NOT THIS . . . piece-by-piece time-consuming removal and reassembly of the 43 major components of a conventional substation.

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PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

PACKAGED POWER

COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Increasing Condenser Tube Life

Care and Maintenance Will Conserve Essential Copper-Base Alloys

At this writing both marine and power plants are permitted to purchase all of the standard condenser tube alloys with the exception of the Cupro Nickels which are still restricted for Government use. This is really welcome news for those power plants whose retubing is long overdue. The engineer can now select something besides Muntz and Admiralty for severe service where the more corrosion resisting alloys such as Cuzinal and Duronze IV will last longer.

However, copper-base alloys are still on the critical and war essential list and must be conserved. How to keep existing condenser tubes in service longer remains the number one problem for the operating engineer. Fortunately, much can be done to reduce the ravages of corrosion if some of the causes are recognized and steps are taken to correct them.

Cleanliness of Tubes Important

Without going into lengthy and complicated scientific explanations as to the various types of corrosion, and their causes, we know, for example, that an accumulation of sand, ashes, shells, weeds, leaves, slime, rust and other debris in condenser tubes tends to encourage pitting, dezincification, and other types of corrosion. Extreme cases have been reported where large pieces of stone or coke lodged in a condenser tube were responsible for severe localized corrosion. The following suggestions are intended to help keep tubes cleaner and thereby prolong their life.

1. Dredge channel and keep intake tunnel clean.
2. Use screens fine enough to prevent debris from entering the condenser tubes.
3. Clean out water box and keep the paint intact.
4. Clean out tubes regularly with high pressure air or water applied at the exit end. The pushing of rubber plugs through the tubes is also effective. Do not use wire brushes.
5. Flush tubes with clean water when ship is in port.
6. If troubled with marine growth, investigate possibilities of using chlorination.

Air in Water Accelerates Pitting

It is common knowledge that air or gas bubbles greatly accelerate condenser tube corrosion. Care must be taken first to prevent excessive air from entering the water, and second, dissolved air must be stopped from separating in the form of bubbles and coming into contact with the tubes. The first is accomplished as follows:

1. Check all valves, bonnets and glands to prevent air from entering water stream.
2. Use a device on water box, such as an air venting system (air and erosion eliminator) for expelling entrained air.

Since reduction of water pressure also causes the release of air, care should be taken, when tubes are installed, not to use protruding ferrules or tubes. Streamlining the water flow into the condenser can be accomplished by using flush type ferrules or by belling and expanding the inlet ends of the tubes.

Bridgeport's New Condenser Tube Manual

Much practical information about the newer types of condenser tube alloys, chemical and physical specification, methods of installing, corrosion research data, suggestions for increasing tube life and many valuable suggestions are published in Bridgeport's new Condenser Tube Manual. If you do not have a copy, why not drop us a line?

Note: Bridgeport products are supplied in accordance with existing priority regulations.

BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN.

ARMY E NAVY

ESTABLISHED 1865

Cooling Tower DOs and DON'Ts
-by MARLEY (No. 2 of a series)

SYSTEMATIC INSPECTION

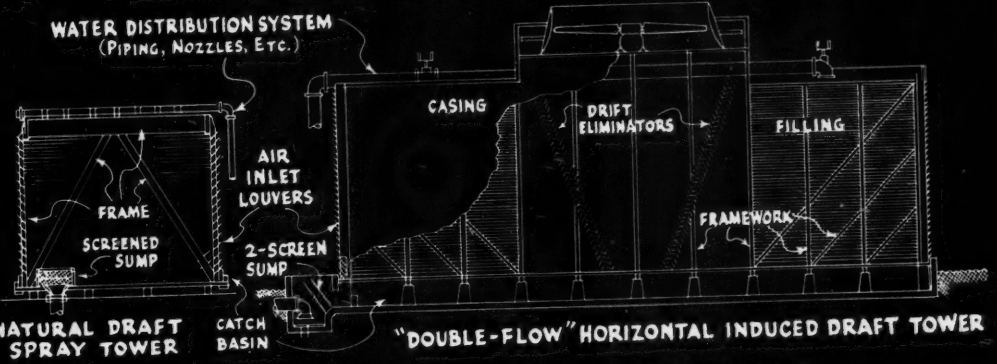
Maintenance time and expense can be minimized and all but routine repairs and shut-downs can be avoided by careful regular inspection. A definite and frequent schedule should be observed —daily for large mechanical draft towers, weekly for small natural draft types.

A thorough monthly check-up should answer these questions:

WATER DISTRIBUTION SYSTEM
- *Supply Piping and Headers—free of obstructions and leaks?*
- *Regulating Valves—operate freely when tested?*
- *Nozzles or other Outlet Orifices—all function uniformly?*
- *Water Pressure—equal over entire system? (In pipe-and-nozzle systems all branches must show even spray. In gravity-flow systems all flumes, launders or basins must be true and level so water is same depth in all boxes.)*

AIR PASSAGES
- *Air Inlet Louvers—unobstructed, none sagging or out of place?*
- *Filling (Decks) and Drift Eliminators—free of obstructions, algea or scale?*

STRUCTURE
- *Bolts of Frame and Casing—tight? (In wood towers, must permit expansion and contraction. Find cause of casing leaks, frame stress, etc., such as foundation settling.)*
- *Metal Parts—free of corrosion? Paint needed? (Examine steel towers closely.)*



CATCH BASIN
- *Basin Water—clean and free of debris, algea or floating matter?*
- *Float Valve (if one is used on make-up)—work freely? Not leak when closed?*
- *Sump Screens—in place and clean? Safety Overflow—open and unobstructed?*
- *Floor and Sidewalls—free of leaks? (In concrete, examine expansion joints. In wood basins dried out during idleness, small leaks close as wood becomes soaked.)*

MECHANICAL PARTS
- *Metal Parts—clean, well-painted, free of corrosion?*
- *Fans—rotate freely? In balance? Blade clamps and hub bolts tight?*
- *Reduction Gears—properly lubricated, operating quietly? No oil leaks? (Slight "play" in gears is normal but, if excessive, indicates wear.)*
- *Drive Shafts—in alignment and balance? Coupling bolts tight? Guards secure? Universal joints properly lubricated? Motors—properly greased? Not over-heating?*

The inspector should report matters requiring attention to the maintenance or operating crew; if of an unusual or serious nature, notify the manufacturer.

MARLEY COOLING TOWERS

24-A

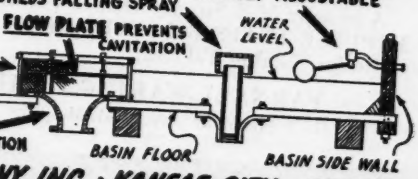
DO YOU KNOW— that these convenient BASIN ACCESSORIES are standard equipment with all Marley basins, redwood or steel.

HIGH SCREEN KEEPS OUT DEBRIS; EACH SECTION INDEPENDENTLY REMOVABLE

BELLED SUMP MINIMIZES WATER TURBULENCE AND FRICTION

OVERFLOW OUTLET PROTECTS AGAINST EXCESSIVE DEPTH OF WATER. "UMBRELLA" SHEDS FALLING SPRAY

AUTOMATIC FLOAT VALVE MAINTAINS CORRECT WATER LEVEL BY CONTROLLING THE ADMISSION OF MAKE-UP READILY ADJUSTABLE



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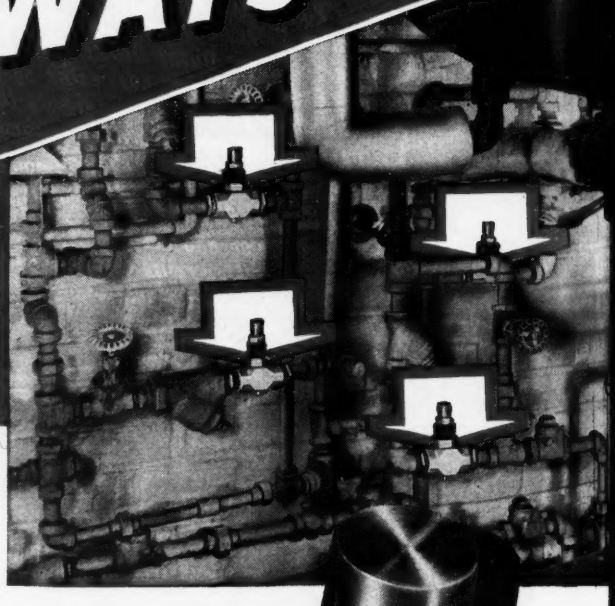
A Sweet Trapping Job by YARWAYS

Efficient Trapping Permits Close Temperature Control ... Vital in Candy Making



MINTER BROTHERS, Philadelphia, makers of delicious fudge, marshmallow and caramel, are standardizing on Yarway Impulse Traps for all their Trapping Jobs.

The reason in a nutshell: "Yarway's continuous discharge on heavy condensate loads and intermittent discharge on light loads, keep steam lines and Kettle Jackets drained, permitting accurate temperature control."

More Than 300,000 Yarways Have Been Purchased

Yarway Trap performance talks. *Quicker heating and greater sustained heating efficiency* soon pay for the installation and continue to return worthwhile profits in plant operating economy. When you consider that their *purchase price* is usually *no more than the cost of repairing an ordinary trap* —why not get Yarway performance for your money?

Then, too, its *small size saves space.* Its *light weight simplifies installation.* Its unique design with *only one moving part* and its *rugged bar-stock construction,* keep down maintenance expense. And Yarway Traps are *suitable for wide range of pressures without change of valve or seat.*

A nearby Mill Supply Dealer handles YARWAY IMPULSE TRAPS and will be glad to serve you. Or write for Catalog T-1738.

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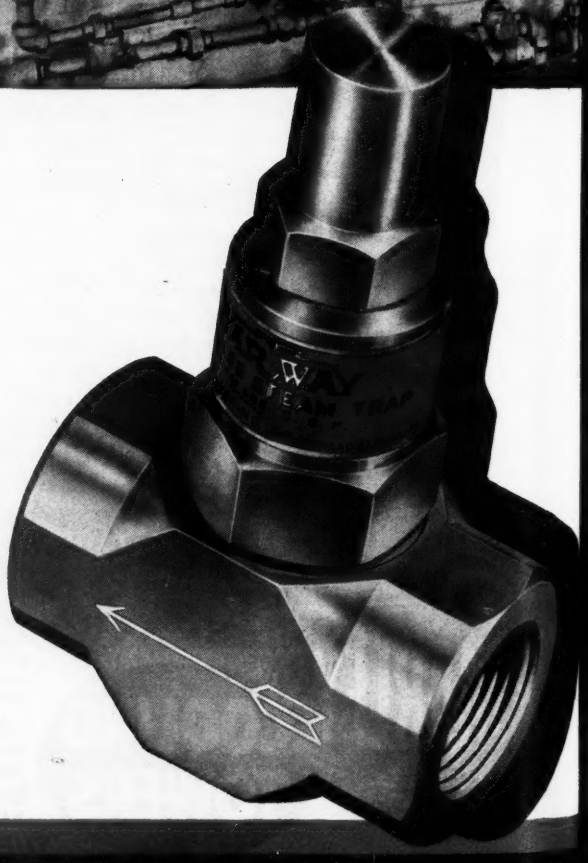


YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

Steam Generation in the U. S., 1933-1943

By E. G. BAILEY

STEAM-GENERATING plants, on both land and sea, are furnishing power satisfactorily for the production of munitions, equipment, and supplies as well as for their transportation — and also for the movement of fighting ships themselves — without the need for any new special designs or major changes in existing types of boiler units. This does not mean that we are using old out-of-date equipment; new and advanced designs of all types of boilers now being used have been largely developed since the early thirties.

The shortage of steel and other critical material has greatly restricted the extension of many electric-utility systems and many industrial plants have been forced to continue with what they had or bring back into use many boilers built fifteen to thirty years ago. This has required that practically all steam-generating units be operated at higher loads and use factors than ever before.

The high-duty service is furnishing an opportunity to determine any shortcomings or limitations that might exist as well as the features of reliability, all of which are valuable guides in evaluating the best designs for the future, when new plants will be built after the war.

Use of welded boiler drums has been a very important factor in connection with higher steam pressures and in the saving of steel. Great improvements in the methods of separation of water from steam are now widely used in stationary and marine boilers with good results which are little short of absolute perfection. During the past twenty years, there has been a steady and permanent increase in the amount and suitability of water-cooling construction for furnaces burning all kinds of fuel. Continued high rating has been made possible by many factors, among which is the important problem of keeping boilers free, or more nearly free, from scale and dirt through chemical treatment of feedwater. In both stationary and marine plants, many boilers, economizers, and waterwalls are now cleaned entirely or in part by acid. Coal burning made great strides in the decade preceding the war, especially in pulverized fuel in the larger industrial and central-station units. The spreader type of stoker has won a position of importance in smaller land boilers and also in coal-burning marine boilers. Boilers are being operated at higher rates and with better efficiency than they could possibly have been without the almost universal use of meters and automatic control of feedwater and combustion conditions and superheat.

In the stationary field, many of the new boilers supplied since this war began have been exact duplicates of, or similar to, units already designed and in operation. This is in contrast to the changes and developments that have been the general practice, especially in the utility field in the past twenty years.

The principal exception to this has been in connection with the synthetic-rubber program which became active in April, 1942. It was suggested that boilers of the forced-circulation type be used as a means of saving steel. After a thorough discussion of the problem, it was found that the saving in weight of steel was about 11 per cent of the boiler unit itself. It was considered best to install practically all boilers for this program of proved types of natural-circulation design, with special consideration being given to the adverse water conditions. The equipment actually purchased has a total capacity of 13,080,000 lb of steam per hr and includes only one boiler of the forced-circulation type, with a capacity of 350,000 lb per hr.

In some processes for the manufacture of butadiene, steam at about 25 psi is heated to 1400 F. Several different designs of superheaters have been developed. Most, if not all, of these superheaters used tubes and headers of 18-8 chrome-nickel alloy. These units are only now being placed into service and results from their operation will be an interesting contribution to our engineering knowledge.

We are fighting this war with a Navy powered with water-tube boilers and geared steam turbines operating at 600 psi and 850 F, having ample power for high speeds, great maneuverability, lighter weight, greater steaming radius, and a fuel consumption appreciably less for the same class of service than in any other Navy in the world, or our own pre-1935 standard.

In the Merchant Marine, all boilers recently built for the Maritime Commission have been water-tube boilers, usually built for steam conditions of 450 psi and 750 F. These boilers have been moderately rated for obtaining great reliability and high thermal efficiency.

An illustration of the trend that may take place in propulsion plants afloat, as increased emphasis is placed on fuel economy, is the 1200-psi reheat steam cycle installed in the *S.S. Examiner*.

Practically all new turbine-driven Lake tonnage is coal-burning and uses water-tube boilers generating steam at 400 psi and 750 F temperature. Coal is usually burned with stokers, mostly of the spreader type.

For years many companies have blissfully developed power and heating equipment which required the use of high-grade fuel without giving too much consideration to the long-range welfare of their customers and the nation, regarding the reliability of the supply and the probable price of the necessary fuel.

Unless substantial oil discoveries are made, we may shortly be forced to import oil from abroad, and probably also make it from coal and oil shale. Any source of additional oil supply will probably result in a sufficient increase in the price of petroleum products to cause a long-time readjustment of the relative economies of oil and coal for many uses in some parts of the country.

In steam-power equipment we have already passed through a period of striving for the highest thermal efficiency, and more recently we have balanced off an over-all economy, considering investment, thermal efficiency, reliability, and operating and maintenance costs. At least, that is what we have striven for, but some of these cost factors do not average out in their true proportions until the plant has been operated for several years.

If the price of fuel and the price of equipment are to change materially, future designs will still have to be made on a basis of estimates and judgment.

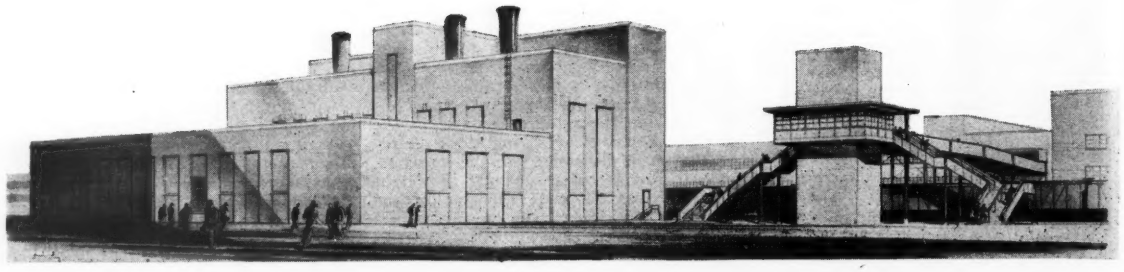
It seems safe to say that we shall probably burn a larger proportion of coal, and that of a lower quality than we used in the past.

Steam pressure will depend upon many factors for each individual case. Many power-boiler units installed in the past five years have been for generation at 900 psi and higher. Satisfactory operation of natural-circulation boilers up to 2500 psi has been established.

As to steam temperature, it also depends upon conditions, one of which is the steam pressure. Many plants have been operating satisfactorily at 850 to 950 F, and it is likely that steam temperature will be further increased as the most effective means for obtaining efficiency at a reasonable increase in cost.

Ervin G. Bailey, vice president of The Babcock & Wilcox Co., was graduated from Ohio State University with the degree of M.E. in 1903, received the degree of D.Eng. from Lehigh University in 1937 and Ohio State University in 1941, and the D.Sc. from Lafayette College in 1942. He began as assistant in the testing department of the Consolidation Coal Co. in 1903, later becoming chief of the department. From 1907 to 1909, he was in charge of the coal department of Arthur D. Little, Inc.; from 1909 to 1915 a partner of the Fuel Testing Co. In 1916 he founded the Bailey Meter Co., and has since been its president. From 1926 to 1936 was president of Fuller Lehigh Co. He has held his present position since 1931. Mr. Bailey has been awarded the ASME Medal for 1942; the Percy Nicholls Award for 1942; Longstreth Medal, Franklin Institute, 1930; Lamme Medal, Ohio State University, 1936. He is a trustee of Lafayette College, a Fellow of the ASME, member of the AIM&ME and the SNA&ME. The above comments are from a recent paper before a joint meeting of the ASME and Engineering Institute of Canada at Toronto

THE ARCHITECTURAL



POWER PLANT ENGINEERS, designers and operators alike, have never given much attention to the architectural design of power plants because, to them, architecture seemed unnecessary. The term architecture implied frills and ornamentation which had nothing in common with the purpose for which a power plant was built. Whatever concept of beauty they had in other directions, their ideas of beauty in the power plant had a background all its own, one quite different from that of the architect or artist. The engineer finds beauty in an engine which the artist thinks greasy and dirty; the artist does not understand the difficulties that have been surmounted in its design. To the engineer, the smell of hot engine oil is like the sweet breath of rare perfume; to the artist, well, confidentially . . . In many cases where architects have endeavored to beautify power plants they have done so without taking into consideration the engineering requirements of the plant. The results were often pathetic.

In recent years there has been a considerable change in the thinking of both the engineer and the architect of power plant structures. They have become more appreciative of each other's functions and have displayed a greater tendency towards mutual cooperation. Fundamentally, the engineer and the architect are working for the same result although because of basic training, one may overemphasize the esthetic, and the other the technical side of the problem. Good architecture means not only attractive buildings but also proper treatment of engineering features; it means attention to such matters as proper clearances around boilers, pumps and fans, provision for maintenance and the inclusion of ventilating facilities both for human comfort and for combustion. Good architecture influences favorable labor relations. Operators take pride in an attractive, well ordered plant designed for convenience and human comfort as well as engineering efficiency; this results in better maintenance. In the past, the dirt and grime and consequent discomfort to personnel have been factors in keeping desirable men away from power plant work.

The idea of functional design has gained favor. People are beginning to see that if a machine or a building is shaped along lines which arise naturally from the scientific laws which govern its operation or use, it is naturally attractive. The modern airplane is a beautiful example of this "functional" design. Its shape is determined entirely by the aerodynamic principles which control its flight. If, 50 years ago, an artist had sat down to draw or paint the most beautiful flying machine he could conceive out of his imagination, he could never have approached anything as beautiful as one of our present-day transport planes, yet the lines of the transport plane are purely the result of engineering design.

Influence of War Plant Architectural Design

During the past four years a great many large war plants have been built in this country, many of which included large power plants. These plants were designed by a comparatively small group of large firms of architects and engineers and despite the pressure under which they were erected, an immense amount of study and experience has gone into their construction. In many instances, these plants had to conform to unusual requirements imposed by defense measures, blackout provisions, for example —not to mention shortages of critical materials. Before the war, to the best of our knowledge, no windowless power plants had been built in this country. Now, that a considerable number have been built, the question is frequently raised, "are windowless power plants going to gain favor after the war?" Most of these plants were built with only one object in view —utility; little attention could be given to architectural embellishment. They were designed along strictly functional lines, yet the results are far more pleasing than those attained in older plants by deliberate attempts at decoration. The very austerity of some of these modern buildings makes them beautiful and impressive.

These matters are of vital importance today because what we think and do about them now will determine post-war development in power plant construction and it is for the purpose of stimulating thought and interest in these things that we present this special section on power plant architecture in this issue. It brings to the readers the combined knowledge and experience of four groups of specialists, those of the editorial staffs of **Power Plant Engineering** and the **Architectural Record** and of two of the country's leading firms of architects and engineers, **Albert Kahn Associated Architects and Engineers, Inc.**, and **Smith, Hinchman and Grylls, Inc.**, both of Detroit, Michigan. The material presented here also appears in the May issue of the Architectural Record. Working in close collaboration with the two firms of architects mentioned, we have endeavored to show how the modern architect and engineer work together in designing a power plant, and how

DESIGN OF POWER PLANTS

such close cooperation between the two groups is influencing the design of power plant structures.

As shown by the many splendid photographs in this issue, the new war plants, despite their simplicity of line, are extremely attractive. The plant shown on the opposite page, for example, is the power plant of the Willow Run plant of the Ford Motor Co., designed by the Albert Kahn organization. It is a windowless plant but note that panels have been provided which may some day be converted into windows. Even without windows, however, the building is pleasing in appearance. The rendering below, on this page shows the power plant of the Lake City, Colo., ordnance plant designed by Smith, Hinchman & Grylls, Inc. The latter is one of a number of similar plants built for the war department throughout the country. From an engineering standpoint these various plants are very much alike but the building structures vary in that use had to be made of whatever building material was available locally. Some were built of brick, others of concrete, some even of wood but in each case the functional idea was adhered to and the results on the whole are pleasing.

Architecture and the Outdoor Power Plant

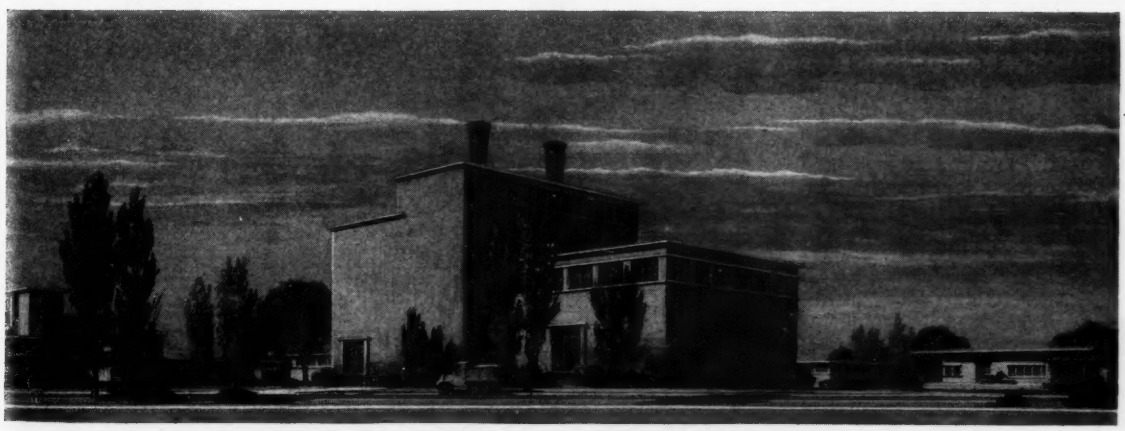
Of course, if the functional idea in power plant design is carried to its ultimate limit, the power generating equipment can be designed for outdoor use and the building structure dispensed with entirely. This, it would seem, leaves little for the architect to do. It is doubtful, however, whether the outdoor type of plant will displace the present, enclosed type of plant to any great extent. In certain parts of the country, where favorable weather conditions prevail, there has been a tendency towards the use of a semi-outdoor type of plant construction. In such cases the boilers are usually placed outside and sometimes the turbines but the control equipment still requires housing, and the proper design and coordination of such units requires considerable architectural skill. The outdoor idea, however, is well adapted to hydroelectric plant design and a number of very attractive outdoor hydro plants have been built.

The question of architectural design of power plants, as already pointed out, is of particular importance at the present time in relation to post-war development. The F. W. Dodge Corporation, publishers of the Architectural Record, has a record of 726 new industrial plants, either in the preliminary or the design stage and 312 electric light and power installations for a total valuation of $320,000,000. What are these plants going to be like? Are they going to be designed along conventional lines or are they going to incorporate radically new ideas, not now disclosed. Consider, for example, the plant contemplated by Joseph Seagram & Sons. In other pages of this issue, are shown two studies of this post-war plant made by Smith, Hinchman and Grylls. One of these involves a design in which the building steel is integral with the supporting steel for the power equipment. In the other study, the equipment supporting steel is entirely isolated from the building structure and a concrete building is shown. The idea back of this separation of building structure from equipment steel, is to provide a means of replacing equipment that may have become obsolete long before the building has outlived its usefulness.

Another factor which has a bearing on this question of architecture, is the fact that when we entered the war some 83 new central stations or additions projected for completion in 1943 and 1944 were canceled by WPB. Some of these projects have since been released and construction on them is proceeding, but what of the others? When the green light is finally given, will these plants be built according to the designs drawn up in 1941 and 1942, or will they be redesigned in the light of new developments in both the engineering and architectural branches of the field?

No doubt those intimately concerned with these matters are thinking about them, but we hope that this section on architecture may stimulate greater general interest in these problems.

The Editors.



Engineering

Fig. 1. Power plant Chevrolet Motor Co., Tonawanda, N. Y., showing provision for expansion. Water and ash storage tanks at fixed end, three boilers and air compressors installed, stack at opposite corner designed for six boilers, expansion of plant to right parallel with railroad track

THE ENGINEERING FEATURES which enter into the design of a boiler or power plant for modern industrial buildings are quite numerous. Among these is the determination of the most suitable location within the property lines.

Factors entering into this decision are the availability of a railway spur line, and suitable fuel storage space. The spur line must be intended exclusively for the delivery of coal or oil to the power house. It must be adequate to hold both loaded and unloaded cars without the necessity for switching to permit the spotting of cars required for other purposes. The storage area must be adjacent to the plant so that fuel, if coal, may be easily stored and reclaimed; or, if oil, sufficient tank capacity either above or below ground may be provided in compliance with requirements of the National Board of Fire Underwriters.

Location Factors

Another factor to be considered is the location of the plant with respect to the manufacturing buildings. This affects the length of piping and other service lines, as well as the usual interconnecting tunnel —all of which, of course, should be as short as possible from an economy standpoint.

The direction of prevailing winds is at times an item to be considered, as is also the proximity to adjacent residential property, because, regardless of the design of or the equipment installed in a plant, a certain amount of soot or fly-ash will be emitted from the stacks, which at times is objectionable under certain conditions. The escape of soot from the stack caused by blowing the boiler tubes has at times caused trouble for plants not equipped with dust collecting equipment. In general, however, the direction of prevailing wind is not a serious factor. Aerial high tension lines or sub-stations so located that the products of combustion pass over the insulators are liable to cause shorting and breakdown due to the coating of carbon particles which accumulate on the surface of the porcelain when moist.

After the determination of a suitable location, the maximum and

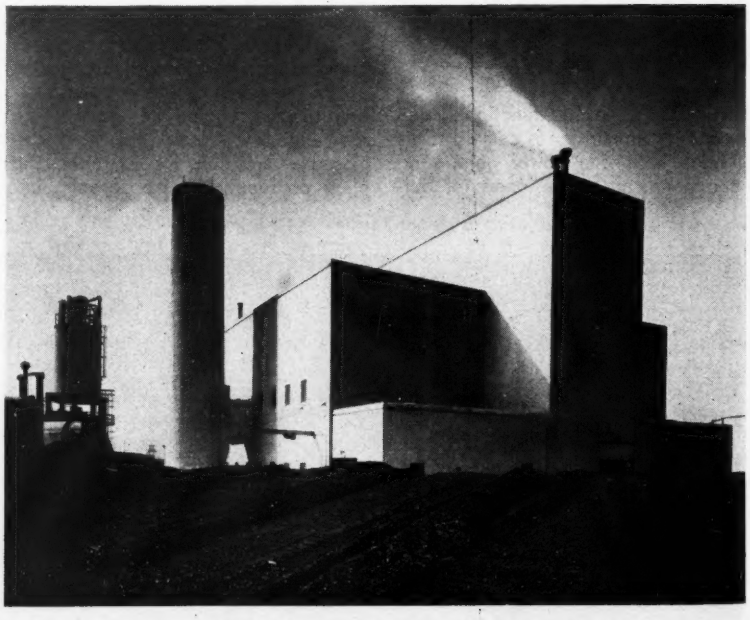


Fig. 2. Power Plant No. 2, Wright Aeronautical Corp., Lockland, O., from coal storage pile, where marks of bulldozer are visible. Short stack conforms with aircraft safety regulations

Fig. 1, Forster Studio; Figs. 2, 3 and 6 by Hedrich-Blessing Studio. All illustrations courtesy Albert Kahn.

# of Power Plants Determines Their Architecture

By F. K. Boomhower

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Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

minimum steam demands are determined from the heating requirements of the buildings served, the process steam load, water heating and other possible uses for steam.

With these figures the size and number of boilers is determined. The size of boilers based on the minimum load is usually such that at the average minimum, one or more boilers may be operated at a good efficiency. The maximum demand then determines the number of boilers required. The efficiency curve of a steam generating unit being quite flat from two-thirds to full capacity permits the designer ample range in the selection of boilers so that three or four units may be found suitable.

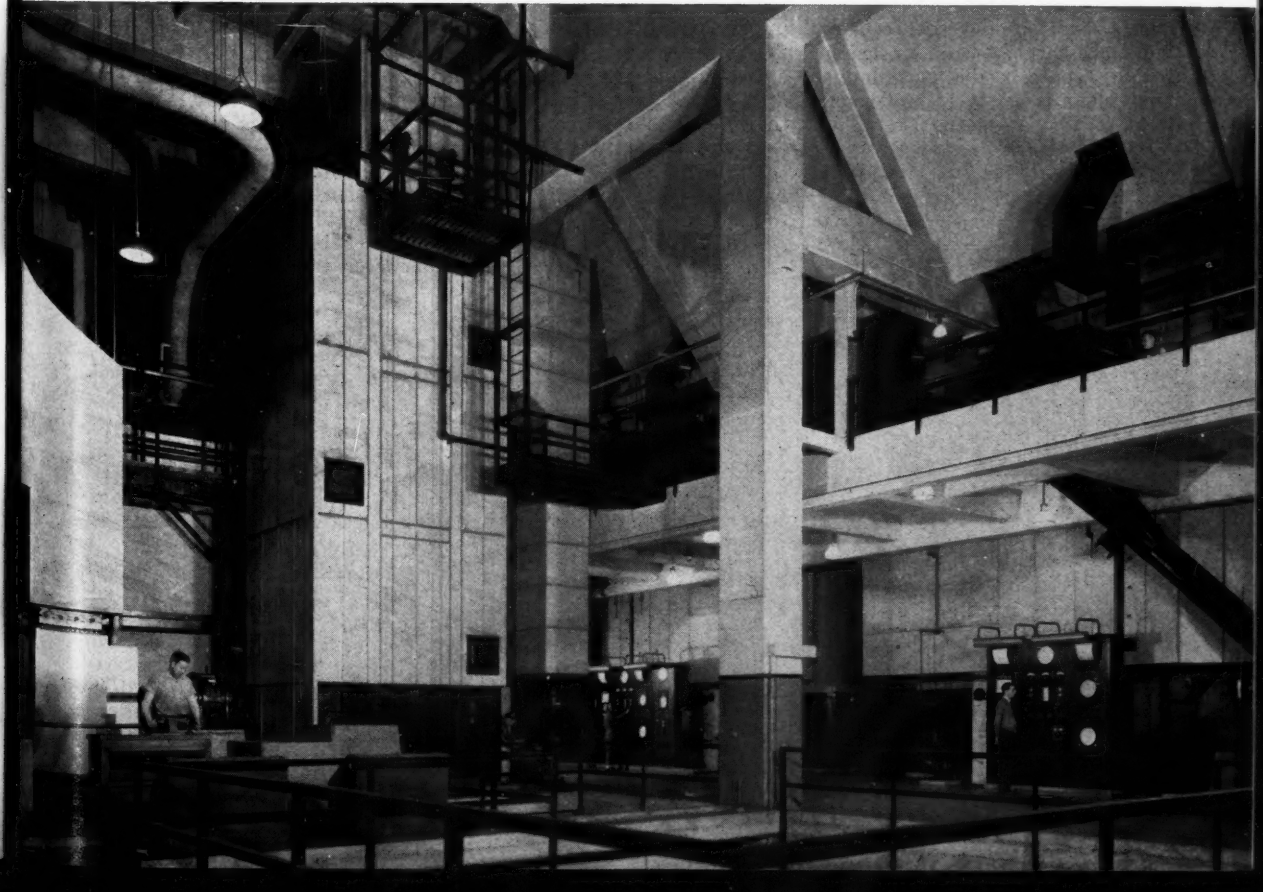
Expansion Provisions

At this point consideration should always be given to the possibility of future expansion, as it has been the history of nearly all industrial projects that they increase in size and output, requiring increased output from the boiler plant. Many plants have been erected where apparently no thought has been given to this possibility, resulting in distorted design, ugly external appearance and generally a makeshift interior arrangement conducive to indifferent and inefficient operation. Figure 1 gives an idea of how these points were considered in designing the Chevrolet power plant.

Following the selection of size and number of boilers, the question of method of firing arises. Three methods are in most general use: viz, oil, and coal fired with either stokers or pulverizers, the decision among them being based on the engineering economies involved and often the preference of the owners' engineers. With oil firing, the problem of fuel storage and transportation is simplified, for no fuel handling equipment is required other than pumps and piping. No space is necessary below the boiler room operating floor, no ash has to be removed and a minimum of soot is discharged from the stacks.

When coal firing with stokers is found advisable, the most suitable design requires a space below the firing floor in which is placed the

Fig. 3. Interior of plant of Fig. 2, showing bunkers, air ducts, control panels, space for future boiler



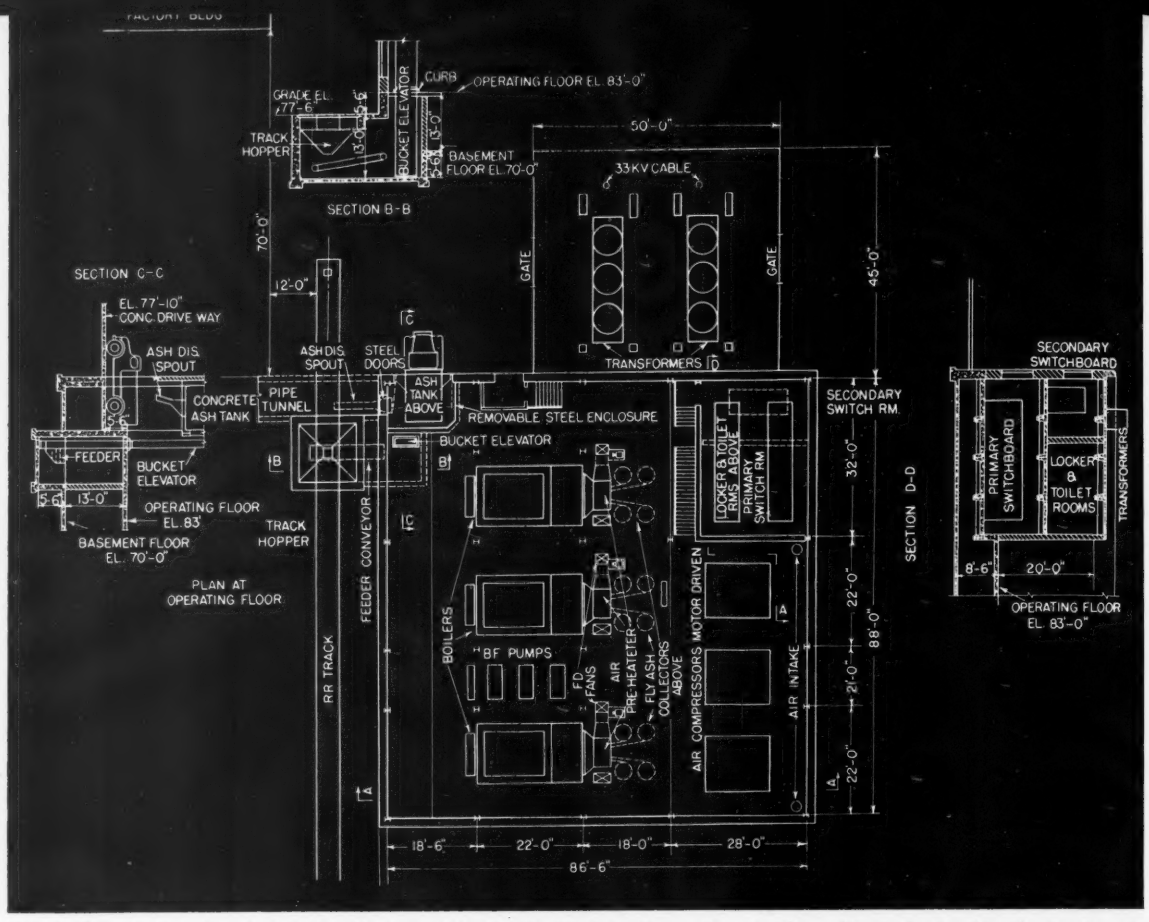


Fig. 4. General plan of a plant. This is the type of drawing furnished by the engineer to the architect, showing him the location of equipment, clearances and other data he needs to design the building

ash hoppers, wind boxes, siftings hoppers, ash removal equipment and a part of the coal conveying machinery. A suitable height for this space in the usual industrial plant is 14 ft from floor to floor.

Coal Handling Equipment

Above and in front of firing end of the boilers, a coal bunker is required from which coal is delivered to the stokers or pulverizers. As a provision for possible future expansion, the bunker should extend along the outer wall of the building, an arrangement which permits a comparatively inexpensive increase in capacity by the addition of a second row of boilers facing the first, both rows supplied from the original bunker and forming a central firing aisle. Typical coal handling equipment arrangements that affect the design are shown in Fig. 5.

Boiler house design should also provide for future expansion, beyond the addition of the second row of boilers as stated above, by addition in length of the building. With this end in view, all obstructions such as track, coal hoppers and ash storage tank should be so placed, if possible, as not to interfere with either side or end expansion.

With space provided for feedwater heater, boiler feed pumps, water treating equipment, forced

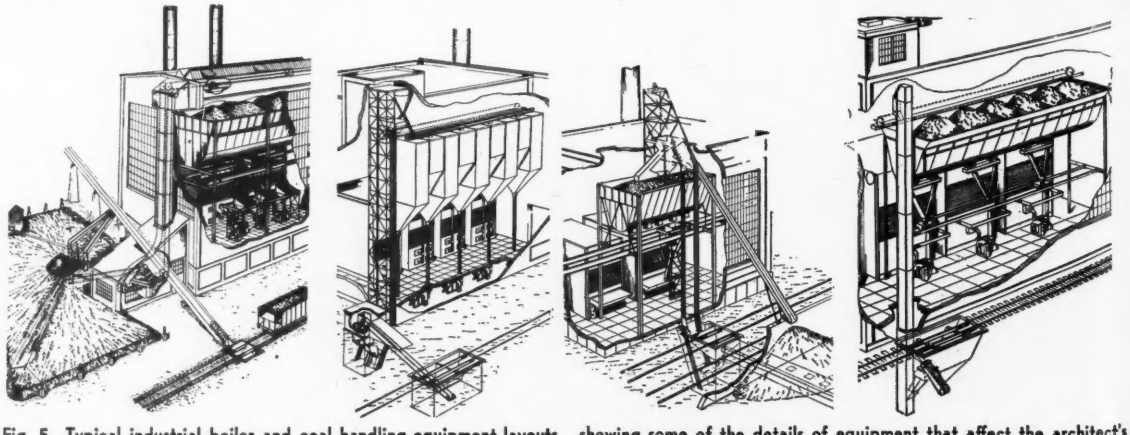


Fig. 5. Typical industrial boiler and coal handling equipment layouts, showing some of the details of equipment that affect the architect's design of the building. Sketches Courtesy of Link-Belt Co.

and induced draft fans if required and suitable space between boiler settings and end walls of the building the size of the boiler room section is determined.

Cost control factors may require that the expense of a coal bunker be excluded, in which case one or more coal silos may be installed outside and adjacent to the building to which coal may be delivered from the cars, stored and delivered to the stoker hoppers by coal handling machinery. This method alters the boiler room design by the removal of the overhead bunker and reduces the first cost of the structure. It does, however, involve a double handling of the greater part of the coal in the silo by the coal elevator and in cold climates the coal, if sufficiently moist, is subject to freezing and consequent difficulties in handling in the silo and in the conveyor delivering the coal to the boiler room. This method alters the design by reducing the maximum height of the building, which with a coal storage bunker is the roof of this section.

Chimneys and Stacks

In designs where natural draft is to be used, a chimney or stack is required which, in nearly all cases, it will be found advisable to superimpose on the building framework at the roof line both from the standpoint of first cost, neatness of design and general accessibility regardless of whether constructed as a self-supporting steel or radial brick stack.

Air compressors, which are necessary in nearly all industrial plants, are usually housed in the boiler house in a section immediately at the rear of the boilers and arranged in a row parallel to the boilers or at right angles. The latter is sometimes more desirable if air conditioning machinery is to be included, as has become increasingly popular during the past four to five years. Locating this equipment in the boiler house is advisable because the maintenance and operation, being naturally a part of the duties of the operating engineers, this work can be done better and with fewer men than if located in the manufacturing building or other point remote from the boiler house.

Compressors or other heavy reciprocating machinery should be placed as near grade level as design conditions will permit, to avoid vibration with a minimum of concrete foundation. The compressor room section should be designed

Fig. 6. Firing aisle of Power Plant No. 1, Wright, Lockland, illustrating details of platforms, clearances, operating space, control panels, illumination, piping and other factors the architect must take into account

with sufficient height to permit the installation of a traveling bridge crane for erection and maintenance, with a hook clearance above the floor sufficient to lift and move the heaviest piece, usually about 18 ft. This governs the height of the compressor room roof.

A partition between the boiler room and the compressor room section will generally be found unnecessary, for it is entirely possible to so design the ash and coal handling and burning equipment as to prevent the escape of dust into the boiler room. With oil firing this problem is eliminated.

A partition, while requiring floor space only equal to its thickness, usually will be found actually to require from two to four feet additional. It also interferes with free access between the boiler and compressor room sections of the building and the ventilation of the boiler room section.

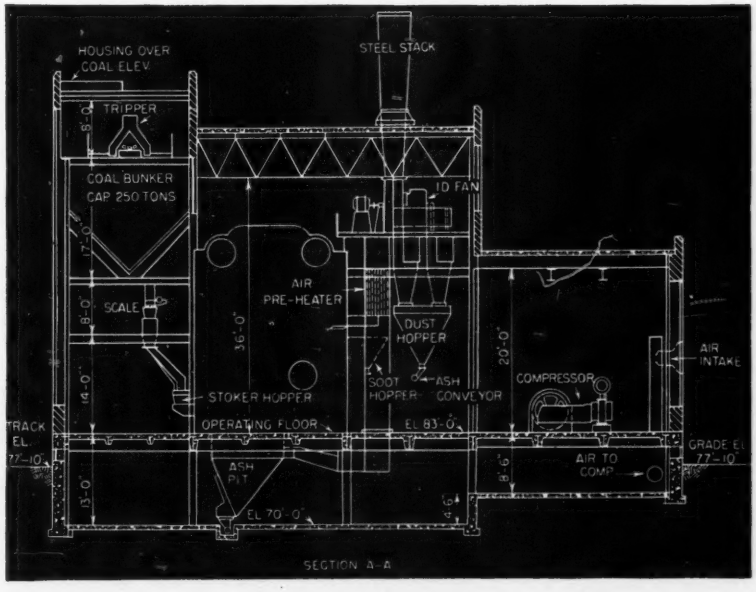


Fig. 7. Cross-section through Fig. 4, a typical drawing showing the architect the dimensions and arrangements determined by the engineers, on which to base building design

THEN—

Remember When They Looked Like This?

Fig. 1—Left. Forty years ago—but this was radical design—they had stokers and a coal conveyor!

Fig. 2—Below. Remember how you used to lean on that cross-bar at the open door—when everything was going well, that is—and listen to these babies? Ah, memories!

LOOKING BACKWARD over a period of about 55 years, we find a steady growth and development in the equipment and design of boiler and power houses for industrial plants which is, of course, paralleled by that of the design, methods, and development of equipment of the manufacturing plants which they served.

Fifty-five years ago these plants almost universally contained one or more horizontal tubular boilers, 100 to 150 hp in size, with brick settings and hand fired furnaces with flat grates, occasionally of the shaking and dumping type. The boilers were set low, the idea being apparently that the boiler shell should be as close to the fire as possible, the rate of combustion per cubic foot of furnace volume being unknown or not considered as an essential factor in furnace design. The ash and coal were handled by hand. Labor and fuel were relatively inexpensive. Feedwater heaters were rarely seen and water was fed to boilers with a good old Hancock "inspirator" or some other make of injector, which was necessarily supplied with unheated water.

A Half Century Ago

At this period, duplex reciprocating feed pumps were sometimes used, in which case heated feedwater could be used. Stacks were usually of steel supported with guy lines or self supporting, constructed from ordinary brick. Water tube boilers such as Heine, Babcock & Wilcox, Campbell & Zell and Altman Taylor were occasionally found, but only in the larger plants. The two latter makes of boilers have long since disappeared from the market.

In some plants, closed type feedwater heaters were installed with reciprocating feedwater pumps, but such installations were a decided minority at this time.

Smoke issuing from the stack was not considered objectionable or an indication of poor combustion; rather was it sometimes considered an indication of prosperity and activity.

Boiler scale on the heating surfaces was a nuisance because, if permitted to become too thick—usually ⅜ to ½ in. was a reasonable limit—it was necessary to remove it to prevent "bagging" the shell over the fire or blistering the tubes. Patent medicines in the form of various so-called boiler compounds of unknown chemical content were fed to the boilers in an effort to reduce or prevent the formation of scale. The chemical content of the feedwater was unknown and the prevention of scale was consequently a "cut-and-try" process, sometimes resulting in foaming and priming in the boilers.

The steam at a pressure of 90 to 100 psi was delivered to one or more reciprocating engines of the slide, piston or four-valve type with a band or flywheel belted or roped to a line shaft, which drove the various units of manufacturing equipment. Condensers were sometimes used if water was readily available, to produce a vacuum for a four-valve engine, but generally the steam was exhausted to atmosphere or partially used to heat the manufacturing plant during the heating season.

Direct-Current Equipment

Direct current generators and motors were in use at this time. In some plants the engines were belted to such generators, or dynamos as they were usually called, and the manufacturing plant would be driven and lighted by such equipment, using carbon filament lamps. The central stations at this time were not serious con-

Figs. 1 and 2 from POWER PLANT ENGINEERING's photo files. Figs. 3, 5 and 7 by Hedrich-Blessing Studio; Figs. 4 and 6 by unidentified photographer; all used by courtesy of the Albert Kahn organization.

and NOW

By F. K. Boomhower

tenders for the manufacturing plant loads, especially if located beyond the point where the size of the copper transmission lines became a problem, because of excessive drop in voltage and consequent poor voltage regulation under variable load conditions.

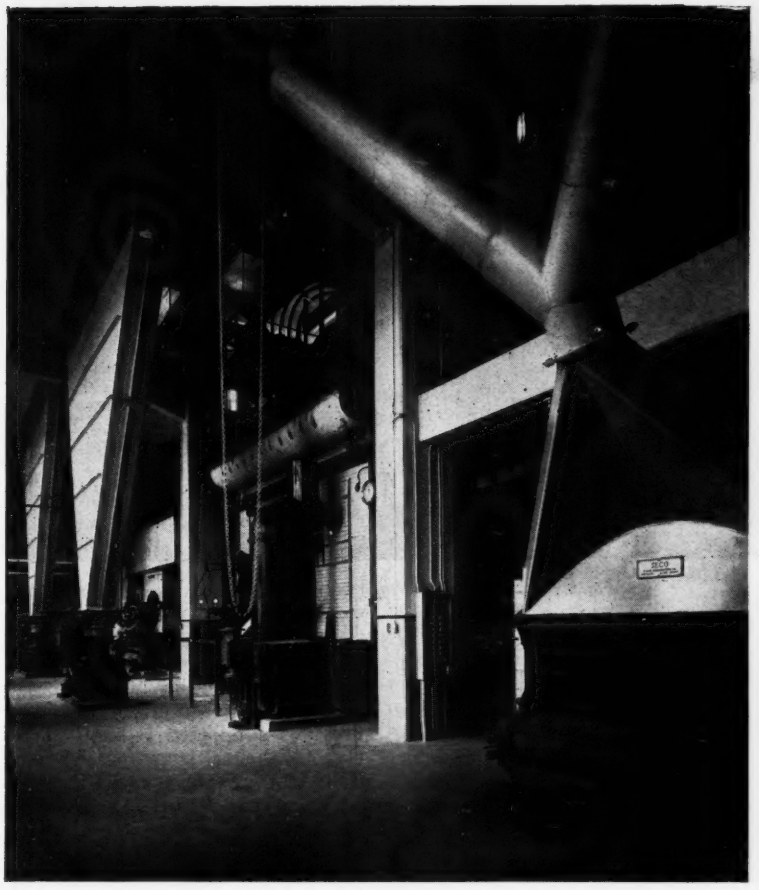
Introduction of A-C

Alternating current, single phase, came into commercial use about 1890 and was used almost exclusively for lighting. The single-phase motor at this time had not been sufficiently developed to be of use, except for small disc type fans. The common frequency at that time was 133-1/3 cycles. The single-phase equipment was rapidly displaced by the development and introduction of polyphase machines, both two and three phase, for which no fixed standard of frequency was established. This condition gradually settled into the present generally accepted standard of three phase, 60-cycle frequency.

This condition prevailed from about 1900 to 1925, during which time the efficiency of central station equipment and the cost of purchased power reached such a point that nearly all manufacturing plant managers found that they could not afford to compete with central stations. From this time on the isolated power generating plant, operating condensing, practically ceased to be a contender against the central station. There are, of course, many instances where the heating and process steam load requirements are such that the power and lighting load may be considered a by-product or vice versa, thereby justifying the use of isolated plant power.

Progress in Equipment

The horizontal return tubular boiler, although capable of efficient operation, is installed nowadays only in relatively small plants because the space required per 1000 lb of steam per hr is relatively large and it cannot be successfully operated at more than about 150 per cent of rating under good condi-



Today They Look Like This

Fig. 3—Above. Three different makes of boilers and two firing methods, due to rapid expansion with available equipment, give unusual design in the Curtis-Wright Louisville plant

Fig. 4—Below. Control centralization and modern equipment cleanliness have led to the one-room or partitionless power plant, like this Burroughs Adding Machine Co. plant

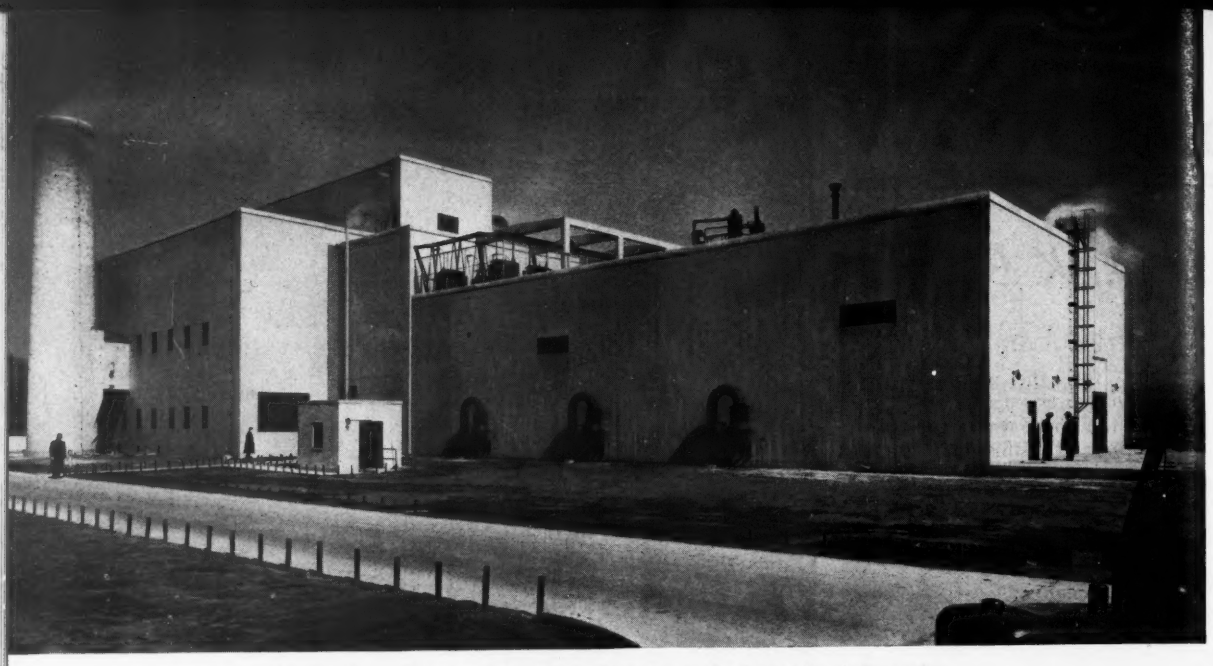


Fig. 5. Another view of Wright Lockland Power Plant No. 2. Short stack for airplane safety

tions. This meant a delivery of about 4500 lb of steam per hr from a 100 hp boiler.

A modern water tube boiler occupying practically the same floor space is capable of delivering nearly 10 times this amount of steam at a much higher pressure.

The increase in the amount of steam generated per square foot of heating surface has caused the development of water treating equipment designed to avoid the formation of scale on the water heating surfaces; the type of equipment and the chemical treatment being directed by specialists in the chemistry of water used for boiler feeding.

The old, solid, heavy brick wall furnace construction has largely been displaced by insulated refractory walls supported by cast brackets supported in sections on structural steel shapes cased with steel plates or transite and cooled by natural or forced circulation of air. The refractory faces of the settings on the furnace side are protected by steel tubes containing water circulating as a part of the boiler water circulating system. Furnace design has developed to a point where the maximum permissible heat release from the burning fuel in Btu per cu ft of furnace volume is quite definitely known for the various kinds of fuel and methods of firing.

The old hand-fired flat grate has gradually given way to the power-operated stoker or pulverizer. Steam pressure and combustion are under automatic control set to maintain uniform steam pressure and the highest average efficiency with variable loads. Feedwater level in the boilers is automatically controlled and the injector has been replaced by motor and turbine driven centrifugal pumps; these feed water to boilers at a temperature of 225 F from feedwater heaters designed to eliminate the dissolved gases, such as oxygen and carbon dioxide, from the feedwater, to avoid corrosion of the internal steel surfaces of the boilers as well as of the steam and condensate piping. Coal is handled to and from a stock pile and to overhead bunkers or silos and to stokers by coal handling machinery, without manual labor.

Fig. 6. Compressor and turbine-generator room in the Ford Bomber plant power house. Note fluorescent lighting, floor and wall details

Fuel Storage

Within the past 6 yr the cause and method of prevention of spontaneous combustion in coal storage or stock piles has become known. The basic cause is oxidation, which is permitted to take place by segregation of the lumps or larger pieces rolling to the bottom of the stock pile. Prevention of this condition naturally may be accomplished by so stocking the coal that segregation is avoided and by preventing air from percolating to the interior of the stock pile by firmly packing the pile.

Ash removal from industrial

plants, formerly a source of considerable nuisance from dust, may now be done without the escape of dust at any point while it is being moved from the ash hoppers to the cars or trucks for removal from the plant.

In many plants where the fly ash and dust emitted from the stacks would be objectionable, it is eliminated by the installation of centrifugal or electrostatic separators, the use of either type requiring the installation of induced draft fans which eliminates the necessity for high stacks.

With the development of the airplane and growth of airplane travel, another limitation has been placed on the height of stacks or chimneys in the vicinity of airports, in that the maximum height shall not be over a line at a 5 deg. angle with the horizontal, with the vertex at the airport.

Developments Influence Architecture

All these developments through the last 50 yr have exerted a decided influence on the architecture of industrial plants. The old plant was usually crowded, little or no thought being given to the possibility of expansion. Lighting was at a minimum. They were necessarily dirty, due to the methods of handling coal and ash; no attention was necessary or given to the comfort of the operating crew. The plant structure was an enclosure to provide protection for the equipment from rain, snow and wind. The plant was usually something which just grew and was treated as an unwanted necessity.

All this gradually changed with the development of plant equipment, until now such plants are usually required by the owners to be designed to include all necessary modern equipment, with ample space provision, light, easy access to all parts of the building by means of stairways and platforms, locker room and other facilities for the operating crew, an office for the chief operating engineer and a small laboratory for checking the water treatment and condition of the water in the boilers.

Improved Conditions Pay

The main operating floors of boiler and compressor rooms are generally red quarry tile or gibraltar floors. Walls are wainscoted up to about 8 ft with salt-glazed blocks. Piping, pipe covering and other surfaces are finish painted to leave a smooth glossy surface—all with the intent to provide an interior which may be maintained in a neat, clean condition with a minimum of effort. The psychological effect alone on an operating crew in a plant well designed and finished is sufficient to return good dividends on the added cost which may be required. This good result is attained through better maintenance and operation than would be obtained with the same equipment poorly arranged and housed in a building designed and constructed at a minimum of expense.

Labor unions have more recently been in a position to dictate, to a certain extent, the physical conditions in the plant under which they will work. This probably is largely due to the shortage of men trained in this class of work—men who prefer to work in war plants where they may obtain higher wages under better conditions. This condition will, however, probably not prevail after the war, but it is entirely possible.

Increased Use of Air Conditioning

Another relatively new development which has altered the design of industrial plants is the use of air conditioning, which is sometimes used to improve manufacturing conditions by maintaining uniform temperatures where sizing machined parts of steel, aluminum and magnesium to close limits, as well as for physical comfort of the employees. This often involves the installation of refrigerating machinery.

An installation of this kind usually requires floor space on two different floor levels, the upper level having a traveling bridge crane for erection of the machines and for maintenance or repair.

A system of this kind usually uses the same piping, pumps and cooling surfaces for a hot water heating system during the heating season, by the use of heat exchangers or steam heaters. It involves a different design of both interior and exterior of the building from that required for the installation of boilers and air compressors only, because of the different levels required and the greater height required from the lower level to the roof.

The future doubtless holds the same relatively steady development in industrial plant equipment as has been experienced during the past 50 yr. The modern industrial plant of today will appear as antiquated in the year 2000 as the plant of 1890 or '95 appears to us at present.

Fig. 7. Firing aisle Wright Lockland Power Plant No. 2, showing boiler control panels

How the Architect Works

By F. A. Fairbrother *Associate,*

Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

IN ITS INCEPTION, the problem of the architectural design of a power house must follow the lead taken by the power department. By this term is meant the division of the mechanical department of our organization that is charged with the preliminary layout of the power house and equipment. Many years of experience and familiarity with different phases of the problem have enabled these men to consolidate their ideas into a form which they have reason to know can be installed in a reasonably proper building.

It would seem that it is of great advantage to have the department charged with such layout an integral part of the whole organization, for it enables the different department heads to confer at will and not be dependent on occasional interviews, as would be the case if the work was carried on by separate organizations.

Deciding on Equipment

As soon as an acceptable layout of equipment has been made and preliminary architectural approval of the size and shape of the building has been given, it is necessary to have all the equipment decided upon at as early a date as possible.

So much variation will be found in the size and types of boilers, stokers, oil burners, pumps and compressors, generators, etc., that it is not feasible to make working drawings for such a building until the equipment is purchased and equipment drawings are in hand.

How Not to Do It

It sometimes happens that such pressure develops to get ahead with working drawings of the power house and try to fit the equipment in afterwards, that the attempt is made to do so (this happens sometimes if preliminary bids that must be taken or other factors compel). The result is always the same. So many changes are required that the plans are practically made over and the office budget for getting out the job takes a severe wallop.

Conditions as outlined above were especially prevalent on war jobs where used equipment had to be installed; sometimes even dissimilar units placed side by side, as in Fig. 3, page 75.

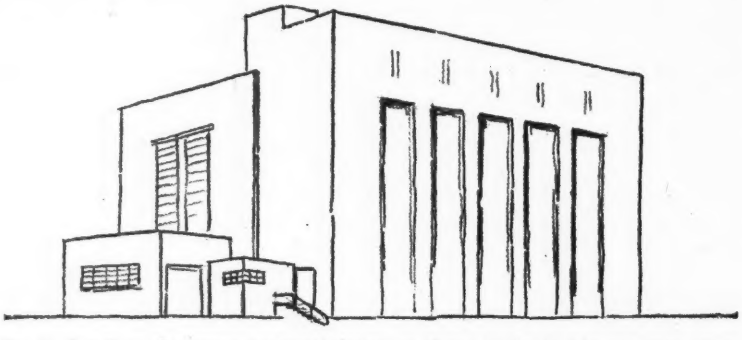


Fig. 1. Based on the power engineers' design, as shown in Fig. 3, plus necessary cross-sections, architects begin to visualize the building in rough sketches like this

So bids must be taken for equipment even before working drawings are started. Meanwhile the designers' room gets busy making studies of the exterior of the building, developing proportions in mass, fenestration and detail. These studies will involve, of course, further consultations with the power department to find what leeway may exist in changing dimensions of rooms, heights, etc.

Architects Work from Engineering Layouts

Shown herewith are some plans and sections of projects as laid out by the power department. In the article by F. K. Boomhower, Fig. 4, page 72 and Fig. 7, page 73 show a typical plan and a cross-section of a power plant as prepared by the power engineers, to show the equipment sizes and locations desirable from the engineering point of view. Figure 3 herewith shows another typical plant plan for architect's reference. This would be accompanied by a cross-section like Fig. 7, page 73. These two happen to be much alike.

It will be noted that the engineers have indicated walls and windows, some general sizes, but especially have shown control dimensions for heights, clearances, etc., which must be observed in developing working drawings. These drawings serve also as the means of

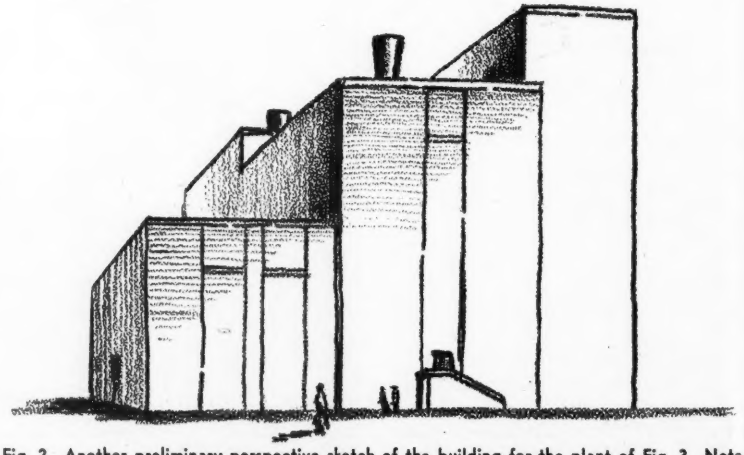


Fig. 2. Another preliminary perspective sketch of the building for the plant of Fig. 3. Note functional design conforming to engineering requirements

obtaining the approval by the client's engineering and operating staff of the proposed layout.

On the basis of the approved engineering layouts, the designers' room will make numerous studies of the exterior, rough at first as shown in Figs. 1, 2 and 4, and finally developing into more definite character, Fig. 5, as satisfying schemes are developed. Figure 6 shows what finally resulted from these sketches. As the equipment to be used is decided upon, it becomes possible to establish definite clearances for boiler framing, supports and framing around compressors, provision for drawing tubes and shafts, etc. At the same time further detailed drawings for piping, installation of equipment of various sorts are being made by the power department and the job captain in the drafting room has his crew under way with the working drawings. Thus by the close co-operation as outlined, the project is converted into a working set of drawings ready for bids and contracts.

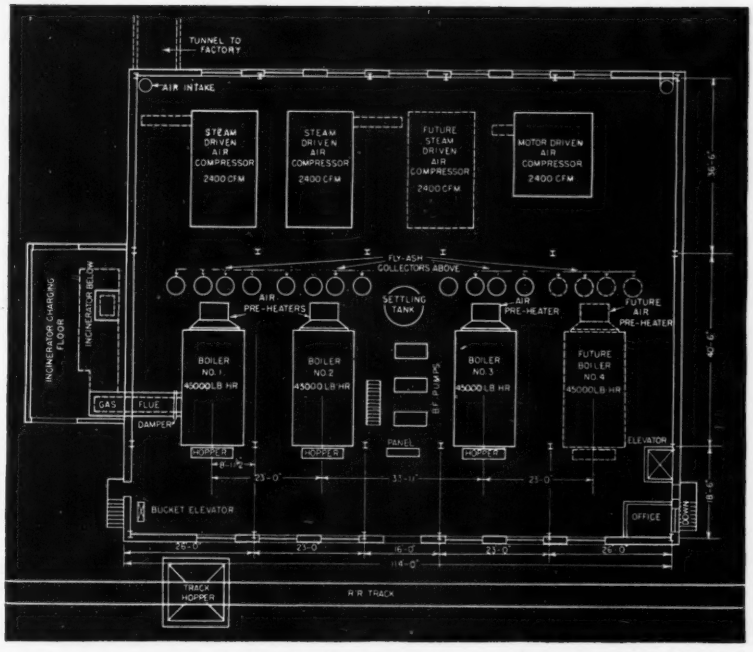


Fig. 3. Typical power plant plan by the power engineering designers to show sizes and locations of equipment, clearances, general location of windows, openings, working areas, would be accompanied by cross-section similar to Fig. 7, page 73

Architect Must Consider Operating Factors, Too

Many details must be considered in the preparation of working drawings where moving equipment must be installed. It must be possible to get the equipment into the structure and equally possible to replace it if necessary because of failure or obsolescence. It must be possible to arrange moving equipment so that vibration may not be imparted to the structure. Therefore expansion joints of proper sort must be provided around the bases supporting such equipment. These joints may be open or filled with a suitable nonextruding material.

An excellent method of treating the bases of equipment, especially where same projects above the surrounding floor level, is to provide, say, a black terrazzo finish on the sides of the bases and a border with a cove at the junction. The border may be made of the width necessary to suit the adjacent finish of the floor, as for instance in the case of the use of quarry tile. This material, we have found, is most excellent for use in the floor of power plants, even around the boilers, because the modern plant is far different in operation from the old-fashioned sort and dust and grime are missing, as pointed out on pages 74 and 75. Well finished floors and walls are most compatible with the sort of building we all like to see.

Making It Pleasant for the Operators

The personnel employed in the boiler house must have suitable office and locker space, also toilet and shower rooms. While dirt and dust from the handling of coal and

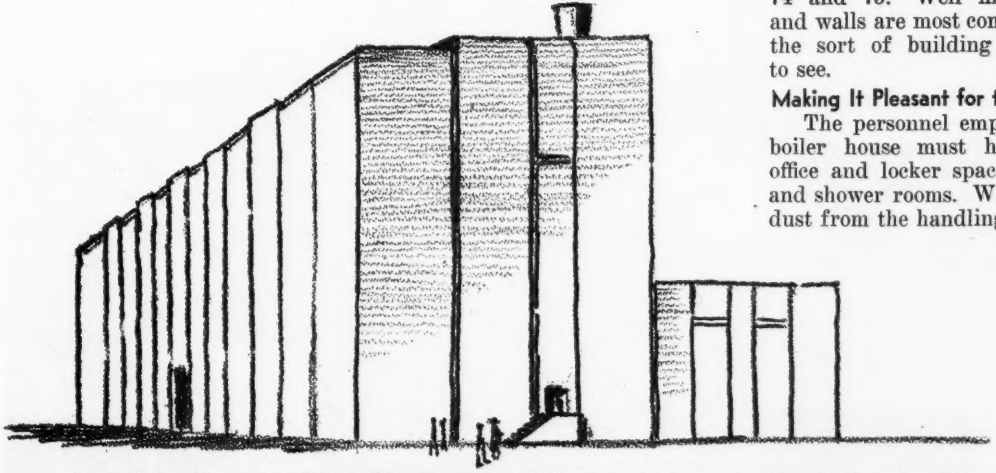


Fig. 4. Still another sketch of the building for Fig. 3. This is still preliminary; no working drawings have yet been made

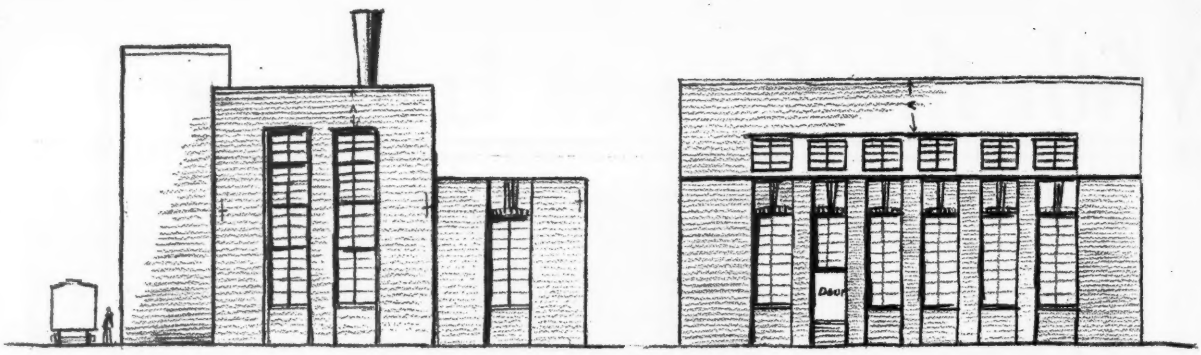


Fig. 5. After equipment is more definitely decided and general layout and appearance approved, Figs. 1, 2 and 4 are gradually worked into more finished elevations of which these two are typical. From these, final working drawings of the building are finally evolved

ash are largely missing, still repairs must be made, maintenance must be constant, and as a result the shower will be most useful. A maintenance shop is very desirable as well.

If windows are provided in the building, most of the ventilation may be taken care of by them. But in the case of blackout buildings some mechanical means must be provided. In either case, enough incoming air must be made available for replacing that drawn out through furnaces and stacks, otherwise combustion will be starved. Excess heat must be easily removed from the upper parts of the building, either by windows or by the use of louvers provided for the purpose.

Inasmuch as large quantities of air are exhausted from the upper parts of the building, cooler air will perforce be drawn in below. Therefore, some heating must be provided in parts where special need exists.

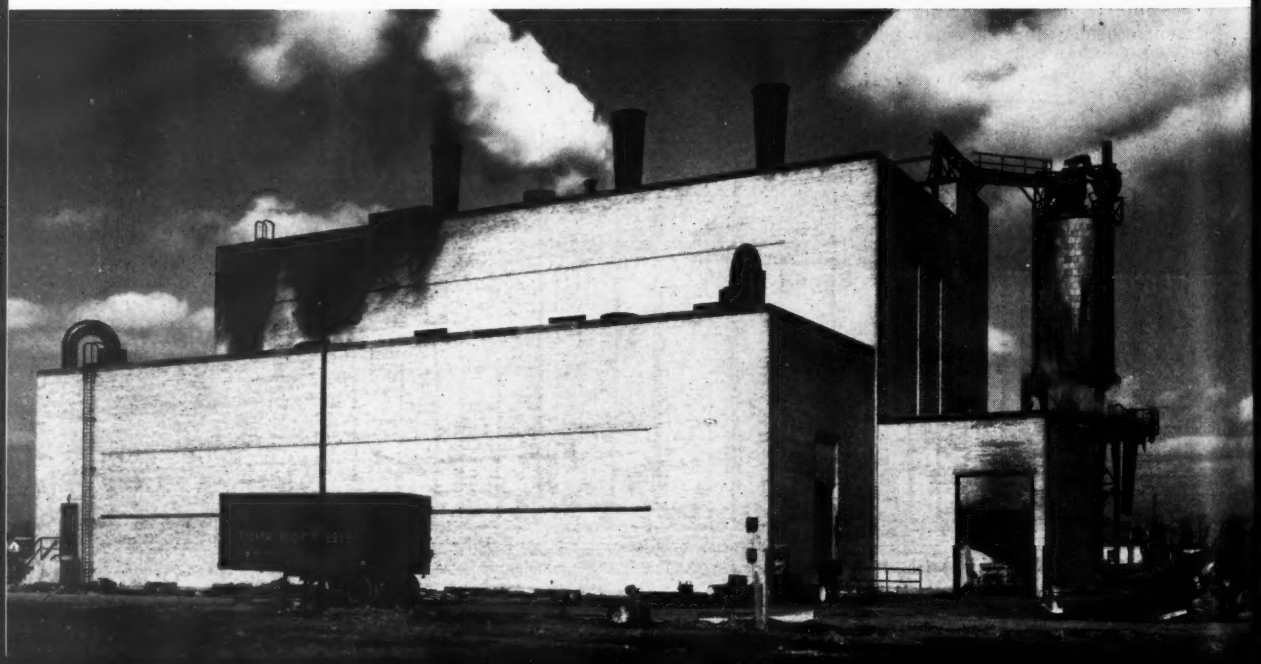
Plant Interior, Definitely Masculine, Can Still Be Attractive

The power plant should not be "dolled-up" any more than the rest of the industrial plant. They both are strictly masculine institutions and should so appear in the character of their design. Therefore, one would find normally little chance to practice "design" in the interior of the power plant. This does not, however, preclude the use of suitable materials well placed.

The color of wall surfaces, both of paint and glazing, can be selected with an eye for suitability. Bands of color can well be used in the walls, either as wainscot or otherwise, and equipment can be of colors to harmonize. Studies on color of machinery as affecting the work of the men using it have been found of value, and the same care may well be used in the problems we are considering.

It has been found wise, wherever possible, to provide stairs between the different levels of the service walkways around boilers and other equipment. Ladders, of course, must sometimes be used, but where they do occur, we have made a practice of providing hoop enclosures around them to prevent falls, much as we have been accustomed to do in other industrial work. Proper railings must naturally be provided around stairs and walkways. Wherever working platforms or walks are provided we have made same to have a curb or other guard to prevent tools being pushed off or dropping on persons below.

Fig. 6. And this is the actual building that resulted from the sketches shown above. Note certain minor changes in window shapes and the fact that the window panels have been filled in with brick to produce a "black-out" design. See Caption, Fig. 2, opposite page. These can be quickly converted to windows after the war. Photo by Chicago Architectural Photographing Co.



Notes on the Architect's Procedure

By

G. K. Scrymgeour

Associate, Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

Fig. 1. A good example of harmony in architectural lines between the manufacturing buildings and the very important power plant that provides the vital power services. Despite difference in fenestration, both have same general feeling

THE ARCHITECT, in accepting a commission to design either a power or boiler house, is immediately faced with the necessity of associating himself with an engineering firm well versed in this type of work, unless he is fortunate enough to have such men within his organization. Together this team will receive the instructions of the plant engineer as to just what is desired: the types of boilers, blowers, compressors and mechanical handling equipment. In some cases, also, refrigeration units will be installed as part of the power or boiler house units. Together the architect and engineer will work along the lines outlined by Mr. Fairbrother in the preceding article.

The architect in general will accept the engineer's recommendations, unless he sees a conflict with the plant's future development, difficulty in bringing in oil and services, or feels that the location is too remote from the plant proper. Minor changes can be made, but in general it is well for the architect to design his exterior along functional lines.

A perspective should be prepared and estimates made of the completed structure, including all trades and equipment. For comparative reasons, it is well to prepare comparative costs between oil and coal, all to be submitted for the owner's approval. Thus the plant engineer is enabled to give the approval and go-ahead for the work.

It is now the duty of the engineer to send out plans and specifications for equipment bids, and until such equipment is purchased there is little the engineer or architect can do within the bounds of safety. Admittedly it has been done, but only where the owner has had definite reasons for the use of certain manufacturers units, or where a new and larger boiler house is to be built, with the understanding that the old and new units are to be of the same make, type and horsepower.

As to design, the architect is free to use his own best judgment—restrictions are imposed by the equipment requirements and by the restricted costs set up in the budget. Blackout buildings, a necessity in these war years, are not advised. Steel sash with ample natural sidewall ventilation is recommended, also positive roof ventilation by the use of motor driven ventilators.

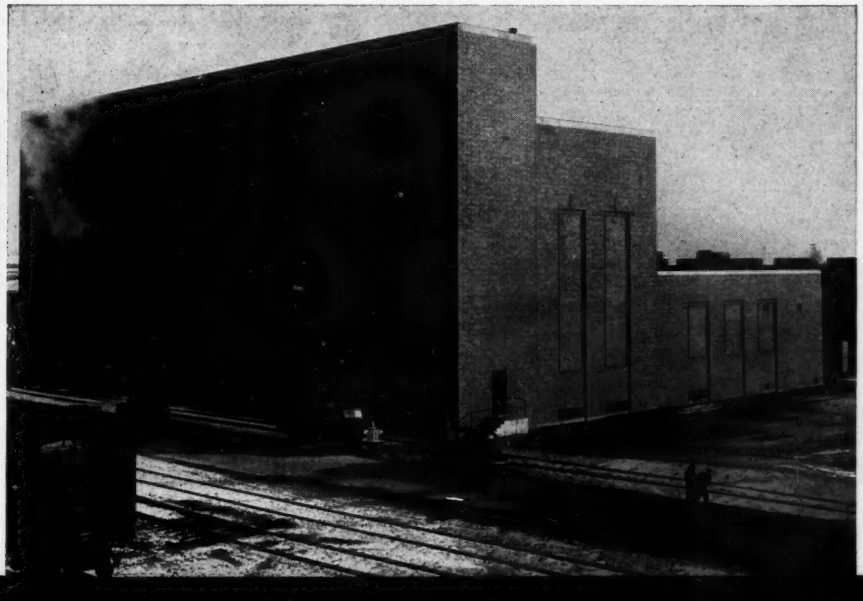
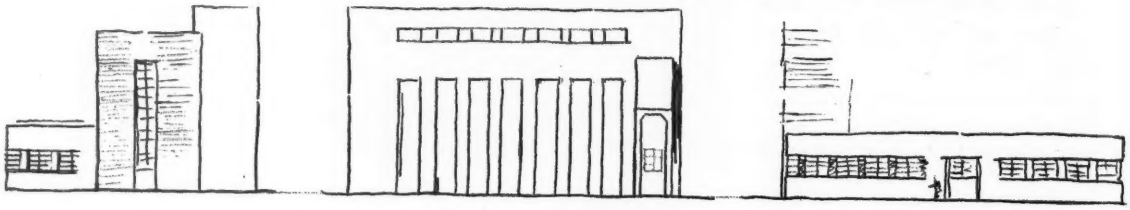


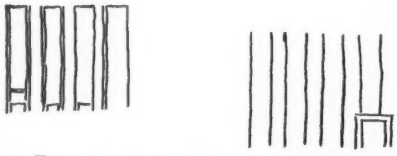
Fig. 2. This view of the power house for the Ford Bomber Plant shows care given to functional design, proportions and relation of masses and especially to the "windows." The latter are typical of installations made by the Kahn organization during the "blackout" phase of war plant construction. Every recessed panel here is in fact a "window" bricked in, framed with steel and ready for steel sash by merely knocking out the brick. Architect must use skill in designing such panels so they are architecturally good whether in brick or glass. The Kahn organization takes no arbitrary attitude on whether the windowless plant is the coming trend or not; it prepares for either contingency in post-war operations

ARCHITECTURAL STUDIES FOR A

The sketches and drawings on these two pages show how the architect develops the building for a power plant from the layout of the mechanical equipment submitted by the engineering department. This layout is shown at the bottom of this page. This provides the architect with his first ideas for the building. From there on, he gradually elaborates until he produces the finished building design shown at the bottom of the opposite page.

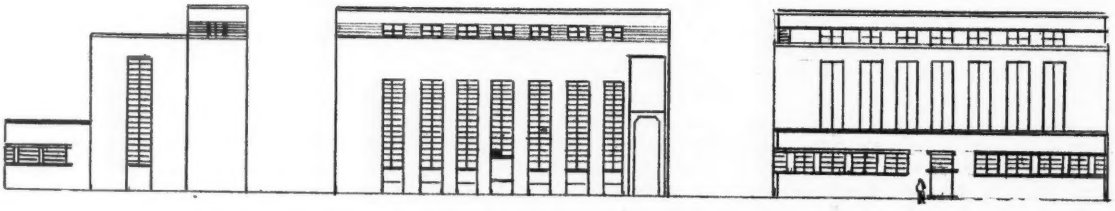


1. A few preliminary sketches outline his first ideas



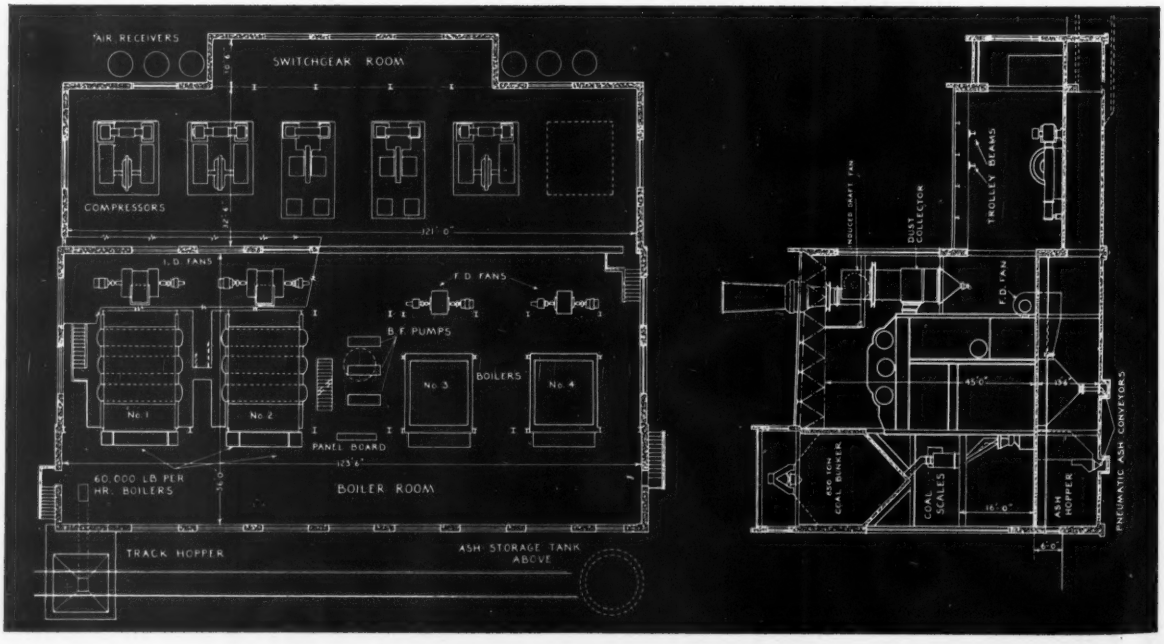
2. Tries out window groupings and shapes

3. Architectural doodling. A certain amount of this goes on during the whole process



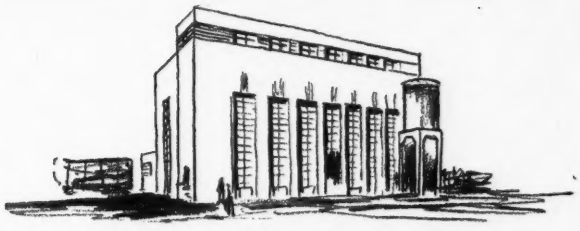
4. Three elevations of a later development. The design begins to take shape

Below is shown the layout submitted by the engineering department

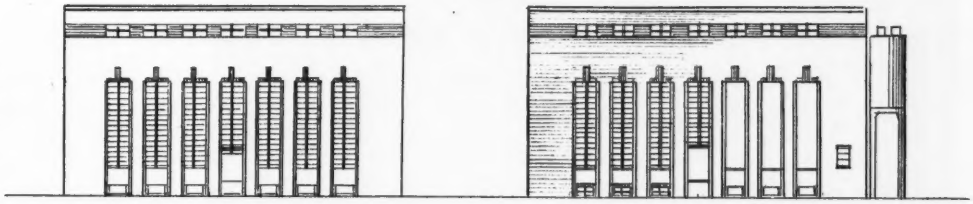


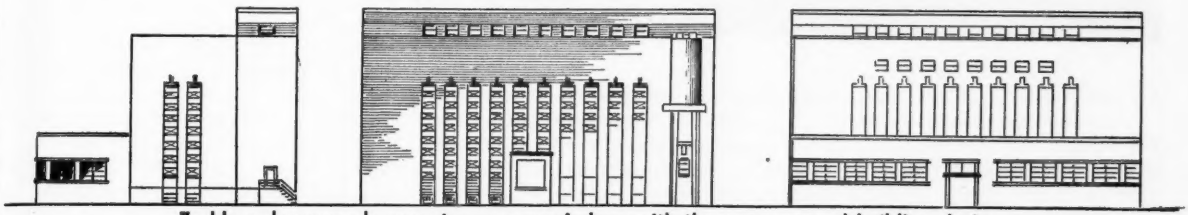
POST-WAR POWER PLANT

5. From the sketches on the opposite page, the architect makes this rough perspective to see how the building will actually look

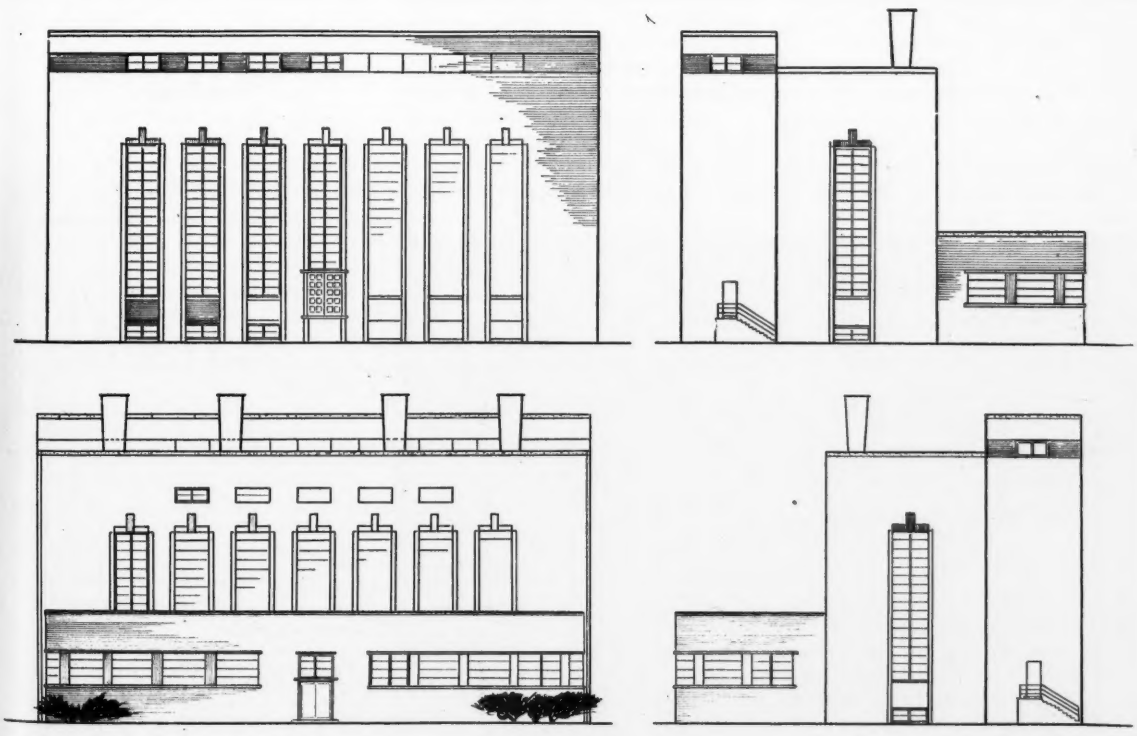


6. Here, he tries a new window design. He seems to like the idea of having seven windows





7. Here, however, he uses ten narrow windows with the same general building design



8. The final design. The architect did not like the ten narrow window arrangement and has gone back to his original idea of using seven wide windows

Studies

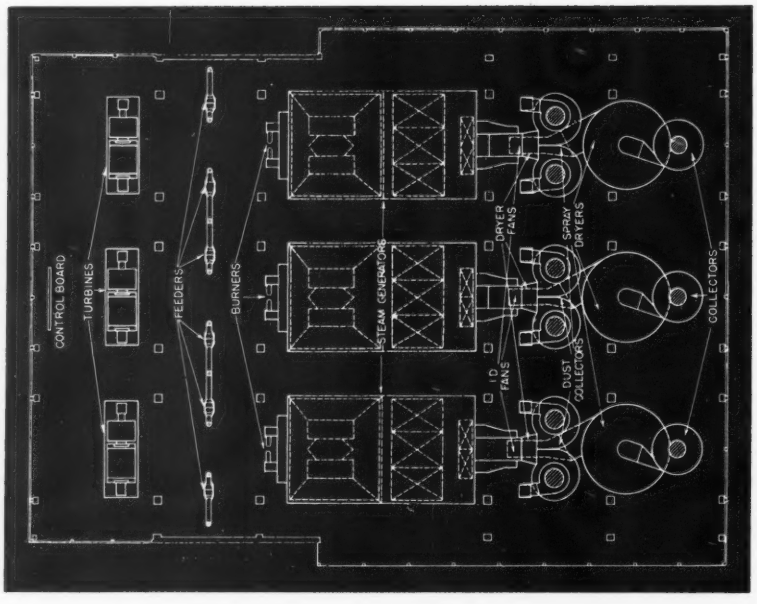


Fig. 1. General arrangement plan of post-war power plant for distillery, showing absence of partition and installation of process dryers behind boilers. This is a composite plan, adaptable to two different types of construction as shown in Figs. 5 and 6

THE INDUSTRIAL work that Smith, Hinchman & Grylls, Inc., has under development, particularly in the chemical and food processing fields, calls for a conception of power plant design that integrates power and steam generating operations with those pertaining more directly to the processing requirements. Representative of this trend are the studies under way for power plant construction at the distilleries of Joseph E. Seagram & Sons, Inc.

In considering the requirements for electric power and steam for the processes which determine the engineering design of the power plant, some understanding of the processes carried on will be of assistance. After a few brief comments on these processes, the design of a power plant to serve them economically will be discussed. Finally, the architectural analysis of a building for the power plant will be shown.

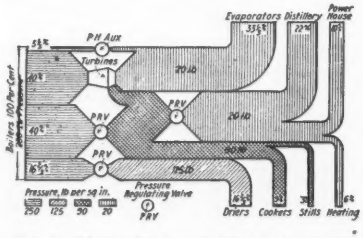


Fig. 2. Chart of steam utilization in a typical distillery

All illustrations in this article courtesy Smith, Hinchman & Grylls, Inc.

Processes Requiring Steam and Power

The term distillery has by common usage come to refer specifically to a plant producing alcohol, particularly to a whiskey distillery. The ethyl alcohol with which we are concerned in a distillery is obtained by the fermentation of sugar in the form of dextrose. This sugar does not occur in this form in the grain used by the distiller, but is present as starch and is converted to dextrose by the action of malt, which is added during the mashing process.

In this part of the process, meal obtained by grinding grain is mixed with water and cooked by steam to expand the cells and gelatinize the starch. This forms "mash", which is then saccharified by the malt, the resulting liquid being known as the "wort". With the addition of yeast, this wort ferments to form the "beer". (This term "beer" does not have the same application as in the brewing industry.)

Alcohol is driven off from the beer in a continuous distilling unit by the application of steam. As recovered from the beer column of the unit by condensing, it is termed "high wine" which, by aging in oak barrels, takes on color and flavor, with some change in the foreign compounds associated with it, and becomes the whisky of commerce. If alcohol in a purer and more concentrated form is required, the high wine is redistilled in the rectifying column of the unit.

By-Products Important in Power Plant Design

Although the production of alcohol is the primary objective in distillery operations, by-products are produced which have some

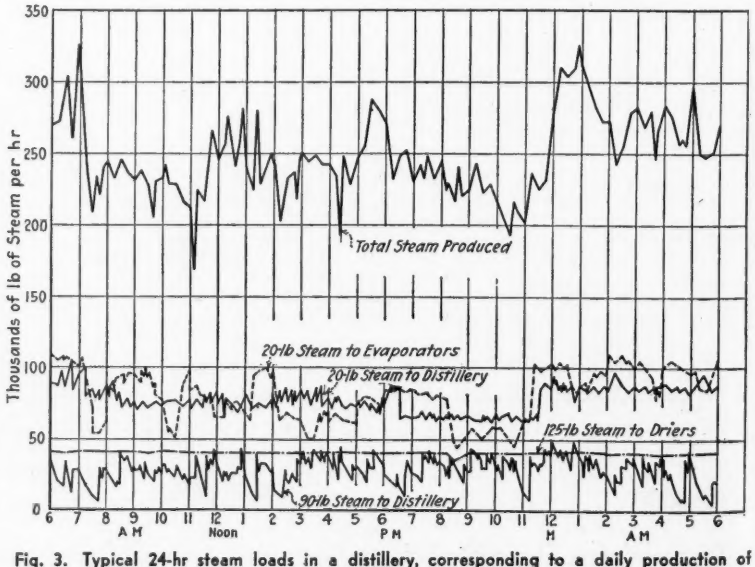


Fig. 3. Typical 24-hr steam loads in a distillery, corresponding to a daily production of 91,000 proof gallons

for an Industrial Power Plant

Engineering characteristics of proposed post-war power plant and how they influence architecture of plant . . . Representative of studies now on boards of Smith, Hinchman & Grylls, Inc., Detroit, Mich., for power plants at distilleries of Joseph E. Seagram & Sons, Inc., also in chemical and food processing fields . . . Intimate relations of power plant and process operations . . . Either integrated or isolated plant structure can be designed to house a particular layout of power plant equipment

effect on the economy of the process and much effect on the requirements for power and steam.

The first by-product is the spent grain that is marketed to compounders of stock food as distiller's grain. This is the grain remaining in the beer as suspended matter

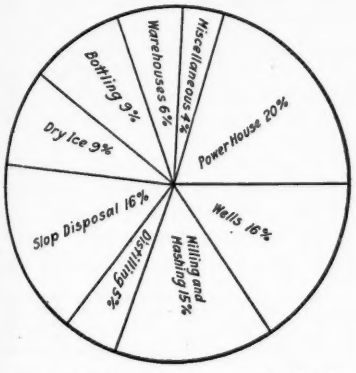


Fig. 4. Chart of electric power utilization in a typical distillery

after the alcohol has been driven off, and is the insoluble portion of the grain that remains when the starch has been removed. This dealcoholized beer, with its grain content as it is drawn from the bottom of the still, is largely known by the inelegant but descriptive term, "slop" but is more appropriately referred to as "stillage".[1]

Other by-products are the CO_2 given off in large volumes in the fermenting process, which may be recovered and liquefied, or made into dry ice, and the vegetable oils obtainable from the grain by degerming before milling or by washing the spent grain with a solvent after drying.

[1] Insofar as plant design is concerned, this material could be processed under the term "slop" as well as under any other name. But Smith, Hinchman & Grylls, Inc., and their clients, have found that the pride and morale of a processing department staff are not increased by handling a material called "slop". The term "stillage" has been adopted, therefore, with such improvement in the standing of those particular operations that today the resulting by-products are as acceptable for food as for feed requirements.

While all processing operations have their effect on the design of the power plant, at least through their influence on the requirements for electric power and steam, the drying operations on the stillage are of particular importance in the designs contemplated by the accompanying studies.

Treatment of Stillage

It is the usual practice to strain the insoluble portion of the grain from the stillage, drying it in a conventional rotary dryer for which heat is supplied by steam, waste stack gases or direct firing. The thin stillage is concentrated in multiple effect evaporators and, in many plants, is mixed with the spent grain and dried with it. More advanced practice provides for separately drying this concentrated stillage, generally termed syrup, a better market usually being obtainable for it when thus processed.

The drying of the syrup may be accomplished on a steam-heated rotary drum dryer similar to that used for producing powdered milk, or it may be dried to a powder in a spray dryer. It is this method of drying that is contemplated by the preliminary designs shown in Figs. 1 and 5.

Capacity of a whiskey distillery is usually given in bushels of grain per day. A plant with a capacity of upwards of 20,000 bushels is considered a large distillery.

Steam and Power Requirements

The diagram in Fig. 2 indicates the typical distribution and utilization of steam for such a distillery, and Fig. 4 similarly covers the electric power. It may be noted on reference to Fig. 2 that the pressures at which the steam is required for processing operations is within such ranges that the greater part of this steam can be supplied as exhaust, or can be extracted, from the turbine-generating units supplying the plant's electric power requirements. Usually these processing steam requirements exceed considerably the amount of exhaust

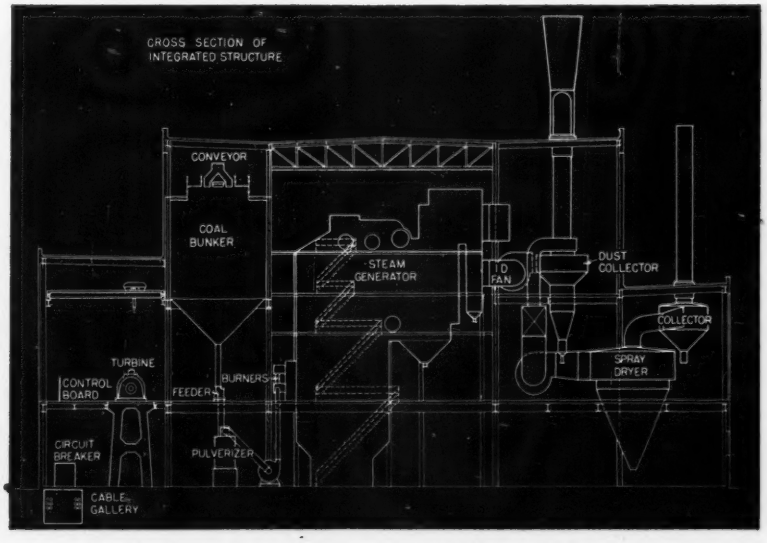


Fig. 5. Cross-section of plant of Fig. 1, showing building in which much of steel-work is integrated with supporting structure of steam generating equipment

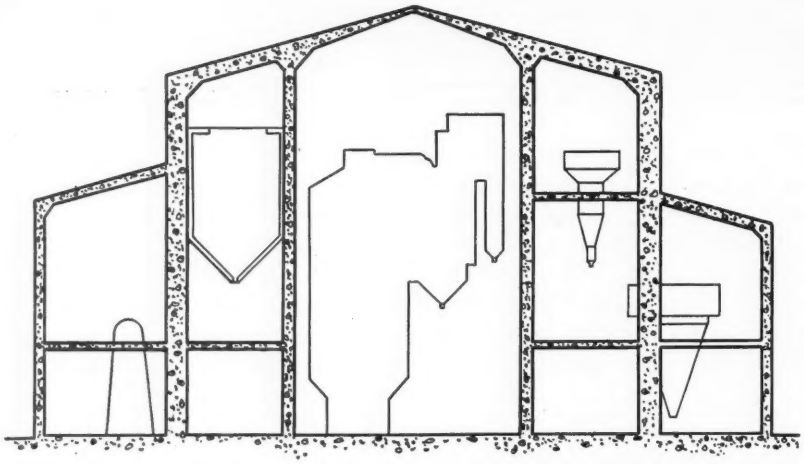


Fig. 6. Cross-section of another building for the plant of Fig. 1, showing how reinforced concrete building can be designed to be independent of power equipment supporting structure

steam available if electric power generation is limited to that consumed by the distillery itself. Also the same general relation holds between consumption of steam and consumption of electric power and the rated capacity at which the distillery is operated as follows:

% Rated Capacity at which Distillery is Operated	Steam Consumption Lb Steam Per Proof Gallon	Electric Power Consumption Kwhr Per Proof Gallon
30	80.1	2.1
40	70.0	1.9
50	63.0	1.7
60	57.0	1.54
70	50.0	1.4
80	47.5	1.26
90	44.0	1.15

From this point of view, the engineers making these studies have found from their heat balance analysis that high-pressure steam generating units are not called for in meeting the design conditions of the moment. It has been their experience, however, that development and improvement of processes and operations in a progressively-operated industrial plant, especially in the distillery field, call for more and more things to be done electrically. Their judgment, therefore, is that in establishing the design of the plant, steam generating equipment should be selected whose pressure and temperature-characteristics will enable electric power to be generated more efficiently than the heat balance requirements initially indicate.

For a particular plant now being planned to serve one of these distilleries in the manner indicated above, Figs. 1 and 5 show the general arrangement and type of power equipment planned.[2] The layout of steam turbine-generators, steam generating units, pulverizers, pulverizer feeders and controls is simple and direct, following modern advanced practice. For flexibility in carrying the load, three turbine and three boiler units are proposed. These would be arranged on the unit or one boiler per turbine plan for both operating and economic reasons.

Stillage Treatment in Power Plant

The unusual feature of this plant, however, is the inclusion within the plant layout of suggested spray drying equipment for drying the concentrated stillage or syrup as referred to above. Behind each boiler unit a spray dryer for this syrup is shown on Figs. 1 and 5. Flue gas from the boiler, after being cleaned in the dust collector following the induced draft fan, would be supplied to the spray dryer by a dryer fan, to furnish the

[2]While the studies and designs are preliminary to construction for the post-war period, Seagram's may make a somewhat temporary installation of one unit at their Lawrenceburg distillery to facilitate war-time production.

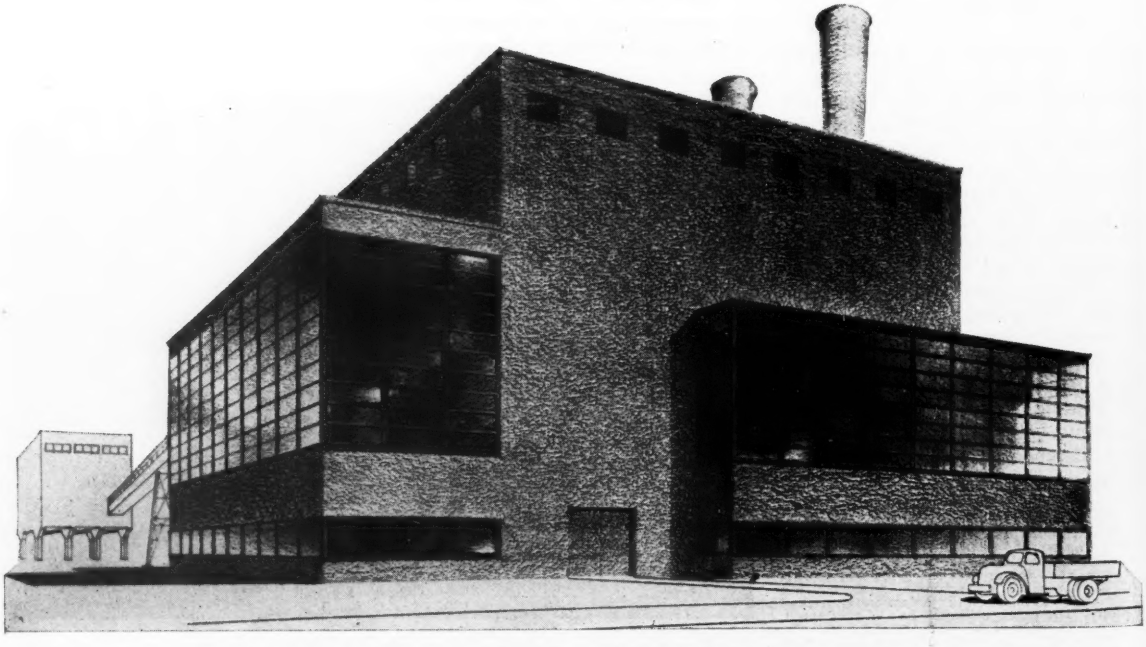


Fig. 7. Architect's perspective drawing of integrated building of the type shown in Fig. 5

heat necessary for drying. The details of apparatus and methods that might be employed in this spray dryer need not concern us here, beyond showing its relative size and location with respect to the other equipment.

Integrated or Isolated Building?

Turning now to the architectural design of a building for this power plant, two ideas are proposed, illustrated first in cross-section in Figs. 5 and 6. Both are, of course, functional, not only in their treatment of the masses of the building with respect to the equipment contained in it, but also with respect to the materials of which it is constructed.

In both cases, the modern trends in window design are noticeable and the window surfaces are naturally part of the mass design as well as of the surface design. The requirements of equipment and operation as specified by the power engineers govern the location and, to a large extent, the size of these windows and are kept in mind by the architect in planning the building. Openings for installation or removal of equipment, working platforms and stairways, clearance spaces and working spaces must also be taken into account.

But when all these factors have been considered, it is seen that the two resulting buildings, shown in Figs. 7 and 8, can have a fundamentally different appearance and architectural effect, while still housing exactly the same equipment.

This difference is produced by designing the structure either as "integrated" or "isolated".

Figure 5 shows the cross section of the plant of Fig. 1 contemplating the use of steel in conventional manner for the structural features of the power house. In this design, the supporting structure of the steam generating unit, at least insofar as its runways and operating galleries are concerned, would be "integrated" with the power house structure.

Figure 6 shows a cross-section of the plant of Fig. 1 particularly adapted for construction of reinforced concrete. In this design, the steam generating unit would have its own supporting structure complete with runways, operating galleries and access stairs independent of the power house structure. This latter might be called an "isolated" structure.

Character of the Two Types

The design contemplated by both these cross-sections is basically the same, particularly in combining with them the drying of the syrup utilizing spray type dryers operated by the stack gases from the boilers. The engineers planning this plant do not represent that the engineering has been carried to a point where this arrangement for supying heat to the spray dryers can be unqualifiedly adopted over other possible methods. But studies prepared indicate the possibilities, and the opportunity for improvement in economy becomes readily recognized. With the arrangement contemplated, the stack gases are discharged, as a part of the vapors from the spray dryer vent, at temperatures considerably below those at which these gases are usually discharged by efficient steam generating units. The reason for this is that they are fully saturated at atmospheric pressure in the spray dryer, hence their outlet temperature from this equipment is under the boiling point. Non-corrosive materials are required for the construction of the dryer equipment in any event, and the handling of the stack gases below their dewpoint does not become a complication.

Functional Design

In both cases, the way in which the architects have exercised functional design is obvious. The principal mass of the building derives naturally from the main bulk of the equipment, the steam generating units and their auxiliaries.

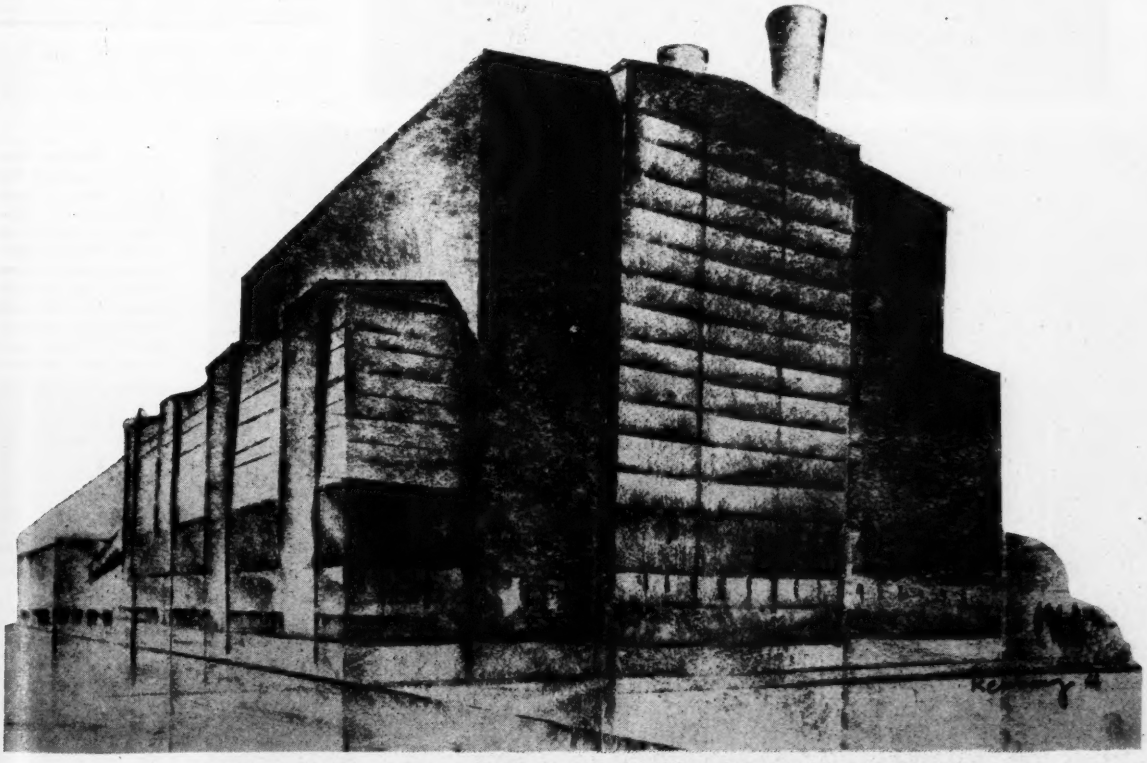


Fig. 8. Architect's perspective drawing of isolated building of the type shown in Fig. 6

Notes on Power Plant Design

By J. T. Cronin, *Designer*

Albert Kahn Associated Architects and Engineers, Inc., Detroit, Mich.

Fig. 1. Installation of refrigerating compressors and auxiliaries Wright Lockland Plant No. 1

LOCATION of the power plant is determined by the following factors:

1. Relation to factory, based on economical distribution of power plant products: steam, electric power, water, compressed air, etc.;
2. Access to dock, railroad and truck facilities for the transport of equipment, fuel, ash, etc.;
3. Provision of clear area for future expansion;
4. Special factors such as distance from landing fields.

Once the location and orientation have been determined, the layout of the required mechanical equipment is made by the engineers.

Architectural studies begin with this mechanical equipment layout as a basis. The basic factor is providing necessary shelter and protection for this equipment, consistent with type of construction (steel, concrete, timber) and choice of materials. The dispo-

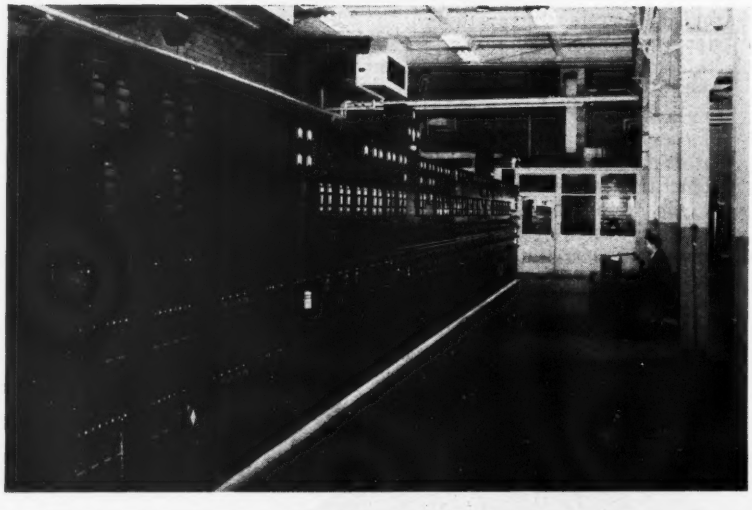


Fig. 2. Main switchboard in Ford Bomber Power Plant is diagrammatic, illustrates modern development of centralized control

Fig. 3. Another view of Wright Lockland Power Plant No. 1 showing architectural details. Projected in 1940, well before Pearl Harbor, to serve a great armament factory, design was forerunner of later ones. Well before we were in the war, Kahn organization had determined on use of recessed panels, bricked in, to be later converted to windows if desired. These must be properly integrated with the whole architectural design. Also note short stacks, an aircraft safety requirement necessitating induced draft fans

Figures 1, 3, 4 and 7 by Hedrich-Blessing Studio. All photos courtesy Albert Kahn organization.

sition of the masses of the building, in general, reflects the heights and areas of equipment to be housed.

Fenestration in some cases has been dictated by blackout requirements, but in general natural light and ventilation govern this item. Suitable doorways, conveniently located, for the passage of the largest mechanical unit are provided together with necessary man doors. Exteriors are sometimes governed by such items as transformer substations; water tanks, high or at ground level; ash receivers, miscellaneous tanks.

Experience has shown that the power house is one item in a plant layout which requires flexibility of planning. Structure arrangement, up until the final stages of the drawings are reached, may be changed, as last minute changes in some basic factor—such as transportation facilities, type of fuel, etc.—may be made, requiring major changes in elevations, orientation, etc.

Many owners and maintenance engineers take pride in a clean well-designed power house. Opinion on this point is heard in almost every case.

The appearance factor is often carried to the point where suitable colors for the interior areas are given more than casual consideration. We have heard this point discussed at inspection of several finished jobs. Proper artificial lighting is, of course, taken for granted.

The feeling of owner, maintenance and operating engineers in many cases seems to be that the power house is the most important single separate unit in connection with a manufacturing plant. As the source of all activity within the plant—the heart of it, as it were—it deserves to express, in its structure, material, equipment, color and general impression of cleanliness and efficiency, its importance in the picture. My personal belief is that manufacturers of various items such as ash receivers, tanks, etc. that frequently are built outside the power house under-rate this "pride-of-ownership" factor.

Fig. 4. Note the fenestration of the Cast Armor Plant boiler house, slightly different from others shown here, but with same emphasis on functional design

Fig. 5. The boiler room of the Ford Bomber plant. Note soot-blower piping details, fluorescent lighting, platform details. While plant was being designed, serious oil shortage threatened, hence designers made provision for burning either oil or coal. Special provisions were made in floor in front of boilers and in furnace details, for last-minute decision to use stokers. Design also provided for possible coal bunkers above firing aisle. Oil-burning was finally decided upon, as shown

Fig. 6. Use of dust-tight coal conveyor, shown just below bunkers at upper rear, permits Chevrolet power plant to be designed with no partition between boilers and compressors

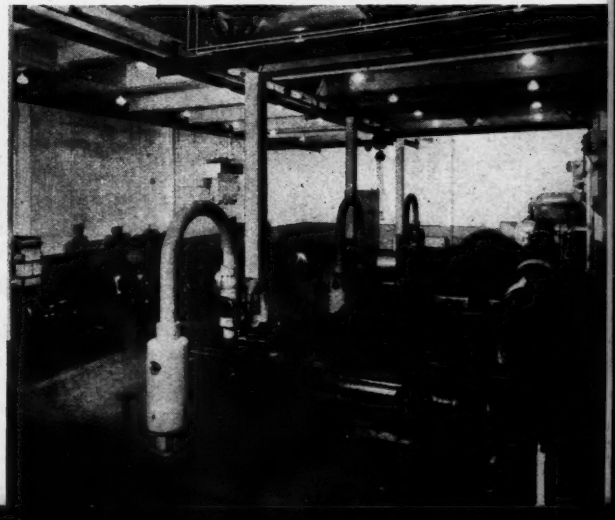


Fig. 7. Air compressor installation at Wright Lockland Power Plant No. 2 showing floor and foundation details, crane rails, good illumination, attractive surroundings

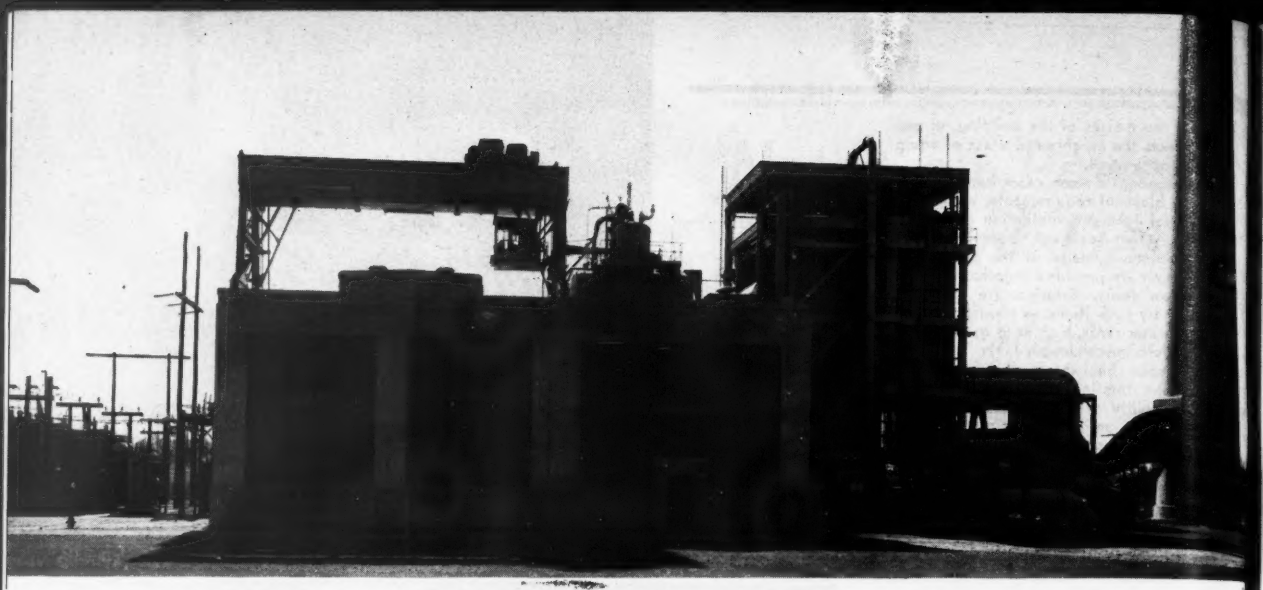


Fig. 1. This view of a semi-housed steam plant, boiler set outdoors, turbine in simple building, with a crane and removable hatch on roof, is representative of the type

Architecture of Outdoor Plants

SUCH PLANTS have been installed by private and municipal utilities wherever economic and climatic conditions justify them. They should more properly be termed unhoused or semi-housed, as pointed out in a detailed discussion of the type in: Some Aspects of the Outdoor Power Plant, by R. H. Emerick; Outdoor Stations Are Simpler, by R. L. Reynolds; and The Outdoor Plant—Is It Here to Stay?, POWER PLANT ENGINEERING, May 1943, pages 72-78. They deserve attention by architects, for in most of the steam plants of this type, either turbines or boilers are housed and it is usually necessary to provide some sort of enclosure for controls and auxiliaries.

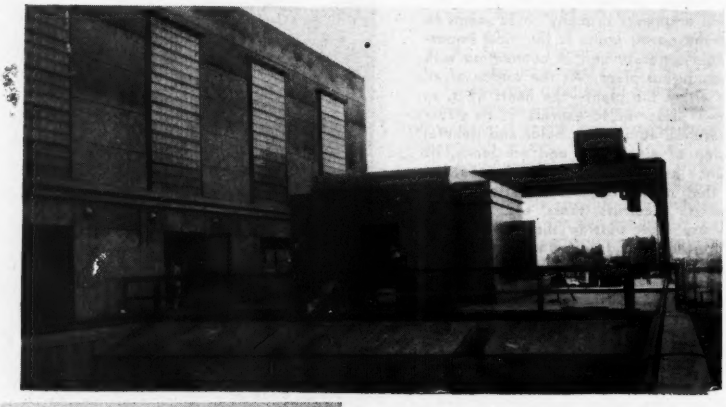


Fig. 2.—Right. Another style of semi-housed plant; boilers in building, turbine outside in its own cubicle

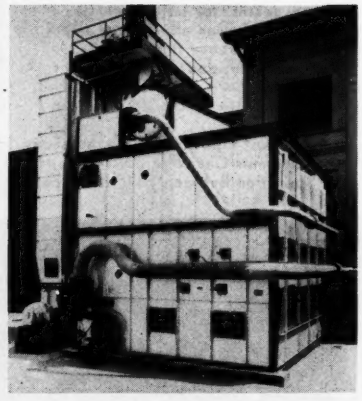


Fig. 3.—Above. Details of an outdoor boiler, its casing and accessories designed for weather protection

Fig. 4.—Left. This view of one of the largest of the outdoor hydroelectric plants shows the fundamental characteristics of the type. These are: unhoused generators; outdoor crane running over generators and waterwheels; transformer and outdoor switchgear assembly and control rooms integrated with dam design

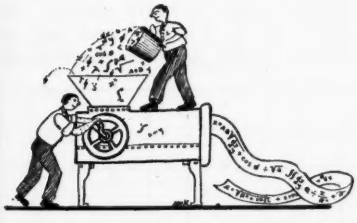
Don't Wince at the Math—Learn to Read It!

Here is an article that gives you the inside dope on this mathematics stuff; no foolin'. Are you one of those people who are scared of mathematical symbols? Do you hastily turn the page when you come to a snappy formula? Do integral signs and trigonometric functions send shivers up and down your spine? Well, don't worry about them any more. Read this article by Mr. and Mrs. Sealey and your inferiority complex in regard the mathematics will immediately disappear. The authors start from scratch and introduce you, one by one, to the whole array of cabalistic marks and pen scratches that, heretofore, have made mathematical papers so formidable for you. They tell you what they stand for, what they mean, and how to cope with them when they suddenly jump out at you from the top of the next page. Don't let us mislead you, however. This article will not make you an Einstein, it will not enable you to calculate your income tax by the theory of least squares or anything of that sort; it merely tells you how to read mathematics, how to appraise formulas and symbols in mathematical papers and articles, intelligently. It will destroy your inhibitions

By W. C. Sealey and Mrs. B. M. Sealey

Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

IN TECHNICAL LITERATURE, it is possible to "read" the mathematics as readily as the rest of the material. The mathematician expresses his ideas in mathematical symbols instead of in words. The symbols are the tools of his trade, which you may recognize when you see them being used, in the same manner that you recognize the saw, hammer, plane or square of the carpenter. If you wished to become a skilled carpenter, you would arrange for a course of training and a period of practical experience, but if you wished only to recognize the tools of this trade, one lecture giving the names of the common tools and demonstrating their use would be sufficient. Such information concerning the tools of mathematics is given here so that, without a lengthy study of the symbols and operations of mathematics, you can learn, not to write it, but to read it sufficiently well to fill in the complete meaning of technical literature.



You put it through the wienerwurst machine of mathematics and out comes the answer

The passages of mathematics found in technical literature are written in a shorthand language in which symbols replace words. Instead of looking like a jumbled code, these passages could appear as recognizable sentences, but then they would be longer and less exactly expressive. A single shorthand phrase, $\frac{PV}{T} = \frac{P_1V_1}{T_1}$ would become a long description of what happens when varying pressures and temperatures are applied to a fixed weight of gas. The shorthand symbols are brief forms for expressing either names or intended actions. A single name symbol represents a "Quantity," which may be one or more things, persons, ideas or relative values. Although the writer may choose any symbol to designate a quantity, he frequently chooses one that suggests it, such as P for pressure, V for volume.

Each passage of mathematics represents the statement and solution of a problem, similar to the written problems of arithmetic or algebra in which it is required to find an unknown quantity, given a set of known conditions. At the beginning, the writer assigns symbols to the quantities involved in the problem. Using these symbols, he sets up a mathematical expression (an equation) showing the relation between them, as he knows it from experimental data. He manipulates this expression according to mathematical laws (keeping the two sides of the equation always in balance) until it assumes a form that gives him the answer to the problem. A college professor described this process to his class by saying, "You set up an equation, put it through the wienerwurst machine of mathematics, and out comes the answer." This is what is being done in every passage of mathematics.

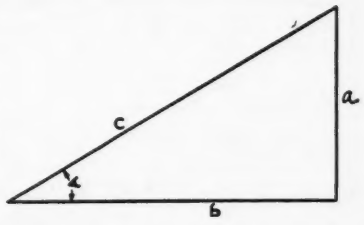


Fig. 1. This triangle will help you in understanding trigonometric functions

Mathematics can be read by translating the symbols into words, concentrating on the statement of the problem and the answer. This procedure is the converse of that by which mathematics is written, where the translation of ideas into symbols is emphasized. Upon translation, the symbols provide the elements for sentences: the names and the words expressing action. The symbols should be translated into words that produce a logical statement, using either the name form or action form of the words as the context may indicate. As a reader of technical writing, you will need to read only the beginning statement which gives the known and unknown quantities and the list of symbols to be used and the final statement giving the solution. You need not follow the intricate workings of the "wienerwurst machine."

Vocabulary of Mathematics

A working vocabulary for reading mathematics consists of word translations for commonly used symbols. This vocabulary does not have to be as thoroughly mastered for reading as it would have to be for writing mathematics. The ability to recognize commonly used symbols is enough, without a knowledge of how to use them. Fortunately, very many of the commonly used symbols are the familiar ones of arithmetic and algebra which need only a quick review. The remaining symbols, those less well known, are reassuringly few in number.

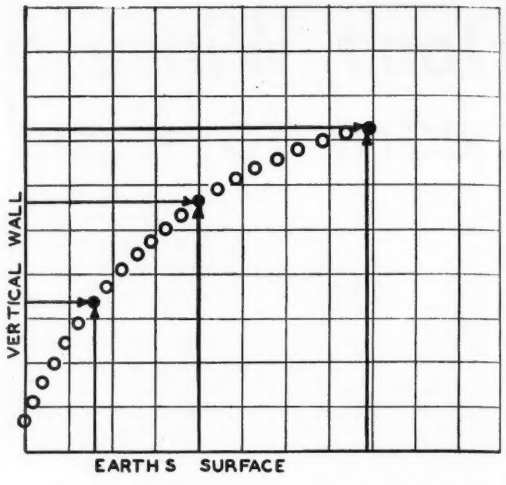


Fig. 2. This graph helps in defining the movement of a baseball in its flight through the air

Example of use	Symbol	Word Translation
$3+2=5$	$+$	3 "added to" $2=5$
$3+2=5$	$=$	3 added to 2 "is equal to" 5
$4-2=2$	$-$	4 "diminished by" $2=2$
$6\div3=2$	$\div$	6 "divided by" $3=2$
$\frac{6}{2}=3$	$\frac{\quad}{\quad}$	6 "divided by" $2=3$
$3\times22=66$	$\times$	3 "multiplied by" $22=66$
$3.2=6$	$.$	3 "multiplied by" $2=6$
$3\,(3+2)=15$	$(\ )$	3 "multiplied by" $(3+2)=15$
$3\,(3+2)=15$	$(\ )$	3 $\times$ "the quantity" $(3+2)$ taken as a unit $=15$
$3\,[3+2]=15$	$[\ ]$	3 $\times$ "the quantity" $[3+2]$ taken as a unit $=15$
$3\,\{3+2\}=15$	$\{\ \}$	3 $\times$ "the quantity" $\{3+2\}$ taken as a unit $=15$
$6°$	$°$	6 "degrees", either 6° Fahrenheit, 6° Centigrade, or 6-360ths of a circle, according to context
$2^3=8$	$(\ )^3$	2 "to the third power." 3 is called an exponent. 2 is called the base.
$2^3=8$	$(\ )^3$	2 "taken as a factor 3 times" $=2\times2\times2=8$
$\sqrt[3]{27}$	$\sqrt[3]{\ }$	"the cube root of" $27=3$
$\sqrt{16}$	$\sqrt{\ }$	"the square root of 16" $=4$
$6>2$	$>$	6 "is greater than" 2
$2<6$	$<$	2 "is less than" 6

The paragraphs that follow are designed to give a reading acquaintance with frequently used symbols of mathematics, beginning with familiar ones and going on to those less familiar.

Word translations for a group of the more familiar symbols are given by means of illustrative examples shown above.

One of the typical features of a passage of mathematics is the frequent use of letters as symbols. Letters are used in mathematics for the sake of convenience, to represent briefly a longer word or expression. You are motivated by the same desire when you call a friend named William Alexander Montmorency by the convenient nickname "Bill." If Bill were to appear in a mathematics problem, his name would be shortened to "B" or "b". In mathematics, you will frequently encounter symbols like B for William Alexander Montmorency, X for the number of bushels of wheat B sold, W for the number of gallons of water per minute, N to replace an unwieldy number.

Greek Symbols

The letters used as symbols come from the English and Greek alphabets. The 26 letters of the English alphabet are all in very frequent use. Letters of the Greek alphabet are sometimes used to name angles as well as other quantities. These five are used frequently:

alpha beta gamma delta theta
α β γ Δ θ

Letters may be given modified meanings by their relative positions or by subscripts. Letter symbols, taken singly, always denote the name of a quantity and not an action which is to be performed.

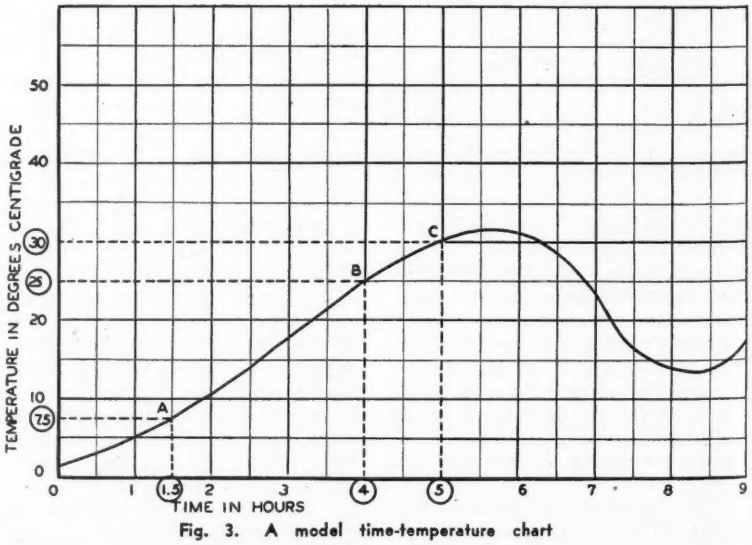


Fig. 3. A model time-temperature chart

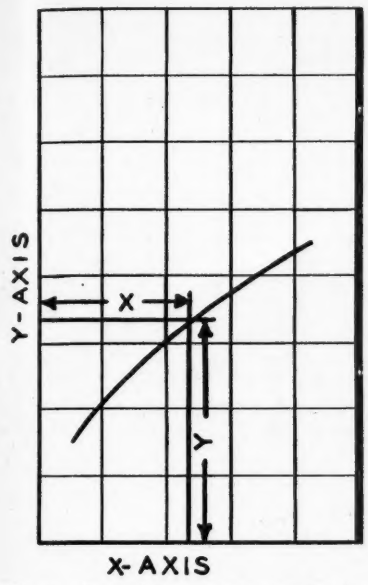


Fig. 4. Any point on a curve can be described in terms of two distinguishable distances

However, the relative position of a group of letters does indicate an action:

PYX means P multiplied by Y multiplied by X

R (M+N) means R multiplied by the sum of M and N

Sometimes, to name a quantity which appears in varying forms in the course of a problem, the same letter is used for all forms and they are distinguished by subscripts: A_1, A_2, A_n, A_x. The symbol A with the subscript 1 is read "A sub one" or "A one."

Six symbolic names taken from Latin are used for naming the relations between the sides of a right triangle. For convenience in explaining them, let us assign symbols to the parts of a right triangle (Fig. 1):

(alpha) for one of the two angles other than the 90 deg angle (either of the two may be chosen)

a for the side opposite angle alpha

b for the side adjacent to angle alpha

c for the hypotenuse

The symbolic names for each of the possible ratios between the sides, and the abbreviated forms of these names, are:

Symbolic name	Abbreviation	Ratio expressed
sine	sin	a/c
cosine	cos	b/c
tangent	tan	a/b
cotangent	cotan	b/a
secant	sec	c/b
cosecant	cosec	c/a

Regardless of the length of sides of a right triangle, the sines, cosines, etc., are the same for any angle of the same number of degrees. Numerical values for these ratios are to be found in published tables. So, when you come to an expression such as, e = E sin 25 deg, you know that e is equal to E multiplied by the ratio of the side opposite to the hypotenuse of right triangle such as in Fig. 1 where the angle A is 25 deg.

Log

The abbreviation "log" scattered through a page of mathematics is evidence that the computations have been made using the logarithms, or exponents of the numbers. An expression such as "$\log_{10} 100 = 2$"; is the logarithmic form of the familiar expression "$10^2 = 100$", and is read in words as "the logarithm to the base 10 of the number 100 is 2". The numerical value of the logarithm to the base 10 of any number is to be found in published tables.

Graphs

The graph is a form used in mathematics for picturing two simultaneously changing values. Its usefulness for the reader of technical writing lies in the fact that it gives a physical picture of ideas, making them more understandable. An example of the graph is the familiar temperature chart, upon which is recorded a series of points representing temperature readings for given times. Notice that the curve drawn through the plotted points of a temperature chart gives a picture of two changing values, the variations in temperature with reference to changing time. As a model for the reading of any graph, let us make a sample reading of a time-temperature graph: (Fig. 3)

Point A is located on a vertical line passing through 1.5 hr, and a horizontal line passing through 7.5 C.

Point B is located on a vertical line passing through 4 hr, and a horizontal line passing through 25 C.

Point C is located on a vertical line passing through 5 hr, and a horizontal line passing through 30 C.

A comparison of the numerical values demonstrates how time and temperature are changing together:

Point	Time	Temperature
A	1.5 hr	7.5 C.
B	4 hr	25 C.
C	5 hr	30 C.
	Increasing	Increasing

This comparison shows that as time is progressing, temperature values are increasing.

The curve of a graph may be thought of as a series of closely consecutive points, like the successive positions of a baseball in its flight through the air. As the ball moves forward (horizontally), its height (vertically) above the ground changes. To define any one position of the ball, two distances would have to be mentioned, its horizontal distance away from the starting place and its vertical distance away from the ground. (Fig. 2.) Similarly, any point on the curve of a graph defines or fixes two distinguishable distances: a horizontal distance away from the Y-axis and also a vertical distance away from the X-axis. (Fig. 4.) In mathematics, the horizontal distance is sometimes spoken of as the "X-distance," or simply as "X," the vertical distance as the "Y-distance," or "Y."

Stated in general terms, the method for getting the meaning of any graph is as follows:

1. Read the names of the two quantities pictured by the graph and the units in which they are expressed.
2. Note the direction in which the numbers on each scale increase.
3. Tracing the increasing values horizontally, note whether the vertical values increase or decrease continuing this process over the entire length of the curve.

If you merely keep these points in mind, you should have no difficulty in understanding the meaning of any graph.

In another article we will consider other symbols and terms used in mathematics.

The Gas Turbine—Part II—By Dr. Sanford A. Moss—Correction Note

IN THE ARTICLE under this title in the March issue, there is a reference on page 80 to Dr. Stodola as "the famous German authority." This reference should be to "the famous Swiss turbine authority, Dr. A. Stodola." This was a slip on the part of the author, for which he is very sorry. It will also be corrected in the complete paper when this is published in the ASME Transactions.

Fig. 1. This striking view of Mystic Station was taken from across the river in Charlestown

Boston Edison Company's newest generating unit . . . placed in operation in November, 1943 . . . Initial capacity, 50,000 kw . . Second unit now being installed, scheduled for operation in spring of 1945 . . . Plant designed for straight 1400 lb operation . . 50,000 kw turbo-generator is a single unit . . . generator, hydrogen cooled, 3600 rpm . . . Built for use of either pulverized coal or oil . . . Located in Everett on the Mystic River . . . Electrical cables carried under the river in an 8-ft diameter tunnel . . . Adequate space for a 400,000 kw ultimate plant if necessary

BOSTON EDISON COMPANY'S new Mystic Station which has been under construction during the last two and a half years is now in service. The first unit, a 50,000 kw turbogenerator together with boiler and auxiliaries went into operation in November, 1943. This station is the latest addition to Boston's electrical system and though simple in design incorporates the most modern features of present day steam generating practice. It is located on the Mystic River in Everett, Mass.

The completion of this first unit at Mystic is a continuation of a Boston Edison expansion policy which began in 1937 and has made available for the wartime electrical needs of the Boston metropolitan area nearby approximately 150,000 kw of additional capacity.

Preliminary work on clearing the site was started late in March of 1941 and the actual construction of the foundation began in July of the same year. During the balance of 1941 and 1942, however, the impact of the war on the deliveries of construction material was so serious that erection of the main structural frame could not be started until January of 1943. At this time much of the material had been received, and it was possible to complete the station, the switch house and cable tunnel during the same year.

The station was designed for an original installation of two generating units, each of 50,000 kw capacity. In August, 1942, however, the priorities which the War Production Board had issued for the construction of the second unit were revoked and it was necessary to complete the station on the basis of only one unit. The foundations for the second unit were completed, however, in February of this year (1944), the priorities for the second unit were reestablished and delivery of the second 50,000 kw turbogenerator is scheduled for the spring of 1945. The facilities of the site are ample to accommodate a station having an ultimate capacity of at least 300,000 to 400,000 kw if this should prove desirable.

Besides the generation of a needed block of power, Mystic Station has deep significance in the development of the Boston Edison Co. system. L Street Station to the east and Edgar Station to the south feed into the highly concentrated Boston load center. Transmission lines and ties from Edgar swing to the west and approach Boston easily from this direction. Mystic will similarly serve the northern side of the Boston load, furnishing an independent source of power. Its switching facilities furnish added protection to local distribution areas and tie in with the main L Street feeders and northern interconnections to the New England Power Co.

Mystic is a straight, high pressure station. The boilers are built for a pressure of 1400 lb and 910 F steam temperature. A single, high pressure turbine exhausts directly into a 33,800 sq ft condenser.

The use of 1200 lb pressure and the "straight through" turbogenerator used at Mystic represents the end of a process of development that has extended over a period of many years in other stations of the Boston Edison Co. It was at Edgar Station, in December, 1925, that the first American turbogenerator operating at 1200 psi was put into service. This installation represented true pioneering in an unknown field and the step was taken to secure the great economies which theory showed to be available by the use of increased steam pressure and temperature. The temperature in use at Edgar Station was 750 F,

Boston Edison's Mystic Station

the highest which could be tolerated by the type of steel then available. Since there was no experience available for high pressure units of a comparable size, a separate high pressure and low pressure unit was installed and the whole station was so constructed that, if difficulties developed, it could be operated at the more familiar conditions of 400 psi, 750 F. As is well known, however, the installation was so successful that four more 1400 lb boilers and two turbines were added to this station.

Edgar Station with its division between the high pressure portion of the turbine and the low pressure part, constituted a precedent for the installation of high pressure "topping" boilers and turbines which became so popular during the depression years. The lessons learned at Edgar were applied in the recent topping turbine installation at the L Street Station. Here, also, the desirable pressure was 1400 psi but progress in the art of steel making at that time permitted the use of 900 deg temperature. This eliminated the need for reheating as was done at Edgar.

The cycle at Mystic is similar to that at L Street, except that the complete pressure drop from 1200 lb to the exhaust pressure in the condenser takes place in a single turbine.

As mentioned previously, the layout of Mystic Station is simple and practical. The initial installation consists of a single Combustion Engineering Co. boiler with a capacity of 430,000 lb of steam per hr. The boiler is of the more or less standardized 3-drum, bent-tube design, characterized by an unrestricted completely water-cooled, bare-tube furnace, a 2-stage superheater with wide tube spacing and reduced gas velocities through the first stage and with the economizer located within the casing under the rear drum. These features will be evident from the cross-section shown in Fig. 2. This design of boiler offers advantages as positive circulation, compact arrangement of the complete unit, controlled gas flow and moderate draft loss.

The boiler is fired with pulverized coal, supplied by 3 Raymond bowl mills, installed on the ground level floor. Triple tangential type pulverized coal burners are installed in each corner of the furnace. The furnace walls are constructed of bifurcated tangent tubes and the furnace is designed for a combustion rate of 24,000 Btu per hr per cu ft. The furnace heat release with this combustion rate is 115,000 Btu per hr per sq ft. As shown by the cross-section the furnace is provided with a water-cooled hopper bottom.

The air preheater is the Ljunstrom, regenerative type and is installed directly above the economizer section of the boiler. From the air preheater the gases pass through Cottrell electrostatic precipitators located on the roof of the

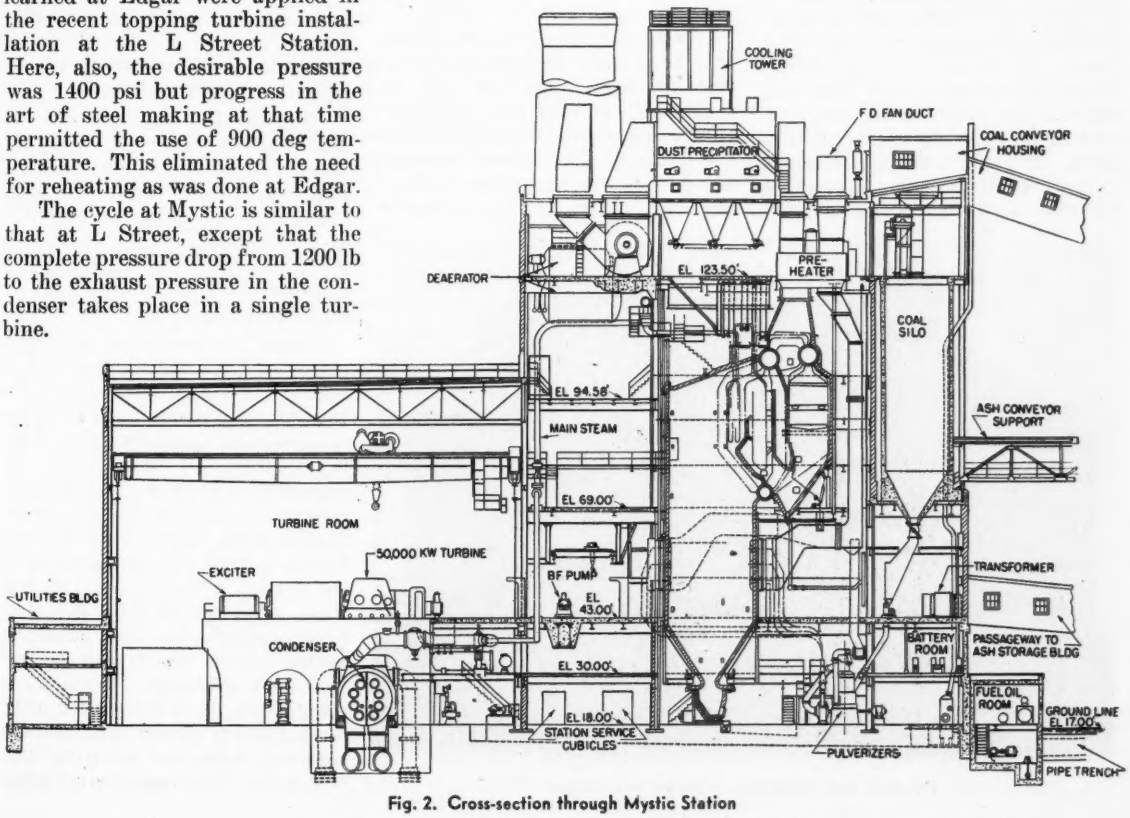


Fig. 2. Cross-section through Mystic Station

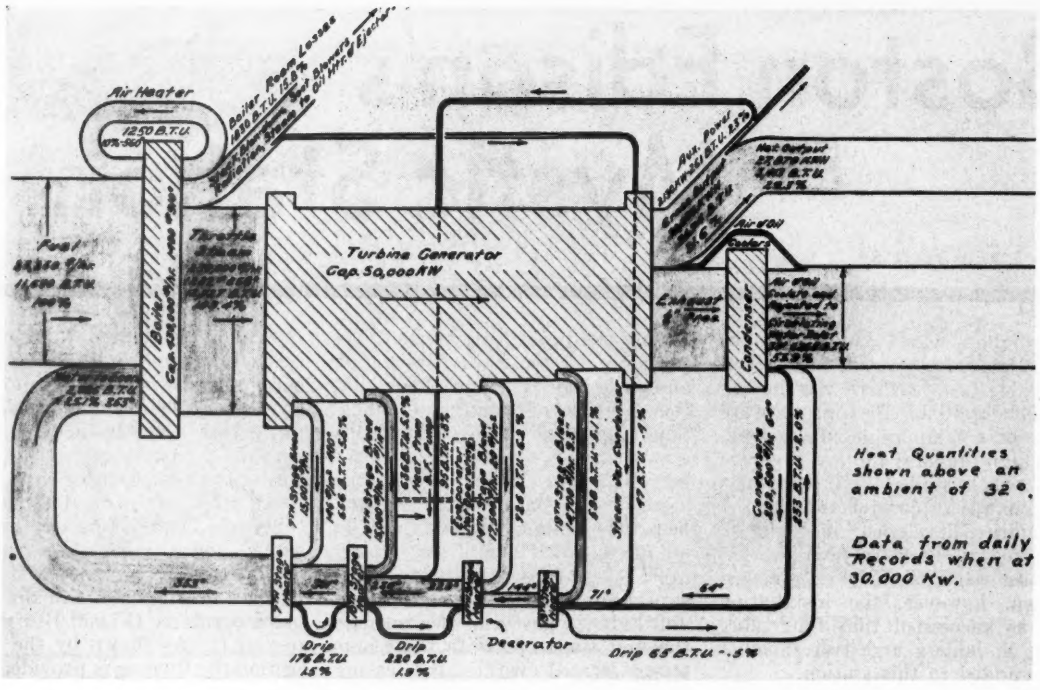


Fig. 3. Heat stream diagram with the station operating at a partial load of 30,000 kw. This is somewhat below the most efficient load

boiler house and then, through the induced draft fans, to the stack. The latter is a radial brick stack.

Coal, for use at the Mystic plant is shipped by boat from Newport News and for the present, will be unloaded by the extensive existing facilities of an adjacent industrial plant. A private railroad siding brings 70 ton cars of coal from this neighboring plant to the coal unloading hopper which, in turn, delivers the fuel to the inclined-belt conveyors which carry it to three 250-ton silos provided for the first unit. The coal conveyors involve some 700 ft of belt conveyor. The general arrangement of the coal handling equipment is obvious from the photograph showing the exterior view of the station on page 94.

As an auxiliary fuel, provisions have been made for burning heavy fuel oil, and a storage tank of 35,000 gal capacity has been provided together with suitable pumps and heaters. The present burners are designed to use either pulverized coal or oil at instant notice as market conditions or emergencies may dictate.

Fig. 4. A view of the Mystic Station switch house

Hydrogen Cooled Generators

The 50,000 kw General Electric Co. turbogenerator unit is a 3600 rpm machine, the turbine being designed for 1200 psi, 910 F. It exhausts into a 33,800 sq ft Worthington surface condenser.

A heat flow diagram for the unit is shown in Fig. 3. This diagram represents steam pressure and temperature conditions when the unit is operating at a partial load of 30,000 kw, somewhat below the most efficient condition. This diagram indicates the general arrangement of heaters.

Steam for feedwater heating is extracted from the turbine at four points, the 7th, 10th, 14th and the 19th stages. Condensate from the condenser at a temperature of approximately 64 deg picks up enough heat from the jet condenser exhaust to raise the temperature to 71 deg at the inlet to the 19th stage heater. Here the temperature of the water is raised to 144 deg. Next it passes to the 14th stage heater which is the deaerating heater where the temperature is raised to 228 deg. The exhaust steam from the steam driven auxiliaries further boosts this temperature to 236 deg and the water then enters the 10th stage heater where

LIST OF PRINCIPAL EQUIPMENT

Mystic Station

Turbogenerator	General Electric Co. Rating: 40,000 kw nominal 50,000 kw maximum Steam Conditions: 1200 psi, 910° Rpm: 3600 Hydrogen-cooled
Steam Condenser	Worthington Pump & Machinery Co. Surface: 33,800 sq ft
Circulating Water Pump	Worthington Pump & Machinery Co. Capacity: 41,000 gpm
Boiler	Combustion Engineering Co. Capacity: 430,000 lb per hr 1400 lb 910°
Fans	B. F. Sturtevant Co. Induced-Draft: 1250 hp Forced Draft: 450 hp
Variable Speed Coupling	Electric Machinery Corp.
Boiler Feed Pumps	Allis-Chalmers Manufacturing Co. 1500 hp
Coal Handling Equipment	Link-Belt Co.
Combustion Control	Bailey Meter Co.
Ash Handling Equipment	Pneumatic, United Conveyor Co.
Feedwater Regulators	Bailey Meter Co.
Stack—make, sizes	Alphonse Custodis Co.
Soot Blowers	Diamond Power Specialty Co.
Deaerator	Worthington Pump & Machinery Co.
Evaporator	Griscom-Russell Co.
Closed Heaters	Foster Wheeler Corp.
Flue Dust Precipitator	Research Corp.
Superheat Control	Leeds & Northrup Co.
Cooling Tower	The Marley Co.
High Pressure and Circulating Water Valves	Chapman Valve & Mfg. Co.
Turbine Room Crane	Shepard Niles Crane & Hoist Co.
Transformers	General Electric Co. Westinghouse Elec. & Mfg. Co.
Switchboards	Westinghouse Elec. & Mfg. Co.
Variable Speed Magnetic Coupling	Electric Machinery & Mfg. Co.

the temperature is raised to 301 deg. It then enters the last heater, the 7th stage heater where the temperature is raised to 353 deg at which temperature the water enters the economizer.

Electrical Features

The 50,000 kw, 3600 rpm generator is a hydrogen cooled machine, with direct connected geared exciter. Current from the generator is delivered directly to the 14,000 v generator bus in the switch house which is a separate building adjacent to the plant. The generator bus, together with its associated switches and cables, is installed in the switch house. Power from the generator bus flows to the main 14,000 v distribution bus which is in duplicate. Current for the station auxiliaries is taken directly from the generator bus.

There are two switch houses, one housing the 14,000 v buses and switching equipment just referred to and the other, a small switch house, for the 25,000 v power bus. Current from the 14,000 v distribution bus is stepped up by the high voltage transformer located outdoors in the yard and then delivered to the 25,000 v bus in the small switch house. All 25,000 v circuit breakers and the transformers are installed outdoors.

As many of the future and existing transmission lines to and from the station must cross the navigable Mystic River, a cable tunnel was constructed to bring the lines under the river. This, in itself, was a major undertaking.

A shaft, 60 ft deep and 15 ft sq was sunk adjacent to the switch house on the Everett side, and a similar shaft was sunk on the Charlestown shore, 1100 ft away. From the Charlestown shaft, the tunnel, 8 ft in diam, was driven under the river, eventually connecting with the Everett shaft. This tunnel is located about 60 ft underground and under water, and is of ample capacity, not only to carry the present output of the station but the cables for the future output as well.

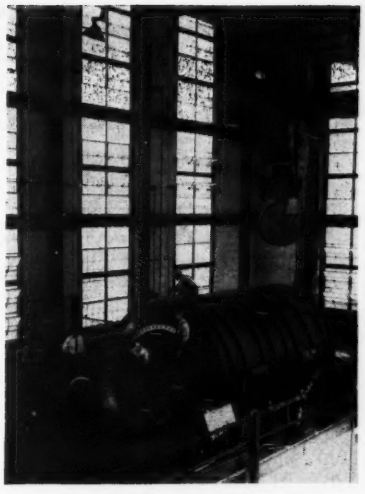


Fig. 5. The 50,000 kw generating unit being installed

As shown by the accompanying photographs, the station is simply but attractively designed of pressed brick and with a short radial brick stack mounted directly on the building steel. The design of the station was worked out by the engineering department of the Boston Edison Co. and Jackson and Moreland of Boston were the consulting and supervising engineers and Thomas O'Conner & Co., the general contractors.

THE FIFTH War Loan will begin June 12th, closing July 8th.

The goal will be $16,000,000,000, of which 6 billions will be sought from individual investors.

A strong patriotic appeal, tempered with a self-interest feature, will be found in all Treasury copy. It will seek to impress upon *everybody* the need for *everybody's* cooperation over and above any other buying he is doing or has done in this war.

More than 55,000,000 Americans own at least one War Bond. That's an average of better than 1½ Bond owners for every U. S. family.

The Gas Turbine—
Especially as Compared to the Steam Turbine

By

F. K. Fischer, Steam Engineer and C. A. Meyer, Development Engineer

Westinghouse Electric & Manufacturing Co. South Philadelphia, Pa.

Principal characteristics of both open and closed gas turbine cycles . . . Effect of regenerating, intercooling, reheating, also of initial air temperature . . . Closed cycle for large units may simplify coal burning problem . . . Use of hydrogen . . . Internally-fired closed cycles . . . Steam and gas turbine cycles compared . . . A look ahead at a number of possible gas turbine applications

ADVANTAGES OF THE gas turbine cycle as compared to the conventional steam system include: (1) no boiler is used; (2) water is not required for the simple open cycle system; (3) it promises greater efficiency improvement at high temperature and (4) it has high hp-per-lb output for short life applications. Present disadvantages include: (1) over-optimism; (2) fuel limited to high grade oils instead of low grade oil and coal; (3) little field experience and need of time to complete technical developments in metallurgy and component parts of the gas turbine system.

There are two basic gas turbine cycles—the open cycle for moderate capacities and the closed cycle for very large units. The open cycle combustion gas turbine eliminates a big and expensive step in providing power to drive generators or machinery. In its power cycle, all the hot gases of combustion go straight to the turbine, thus eliminating the steam boiler. By contrast, in the highly developed steam cycle, the fuel energy must be converted to steam before expending its energy in the turbine.

The Gas Turbine Is Simple

The gas turbine employs the simplest power cycle known, consisting of three major elements: a compressor, a combustor and a gas turbine, as shown in Fig. 1. These three, plus a generator or shaft for transmitting the useful power output and a means of starting, give a simple arrangement called the open cycle system.

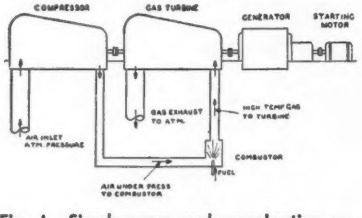


Fig. 1. Simple open cycle combustion gas turbine

In the simple cycle operating at 1200 F, the products of combustion (gas) contain some 600 per cent excess air. This gas is expanded in the turbine and exhausted to the atmosphere. No intermediate fluid is used as in the steam cycle. The steam generator, or boiler, is the biggest single element in the steam power plant. In the gas cycle a compressor and combustor replaces the boiler, resulting in a much smaller and more compact power plant. Because the simple open combustion gas cycle does not require cooling water, no steam condenser such as used in the condensing steam cycle is needed and plants may be located without re-

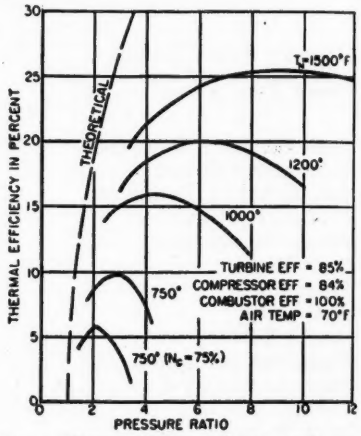


Fig. 2. Thermal efficiency of open cycle gas turbine, without reheat, intercooling or regeneration

Table I. Comparison of different open cycle arrangements

Item	Simple Cycle	Cycle with Regeneration	Intercool & Regenerate	Reheat & Regenerate	Intercool Reheat Regenerate
Input in Fuel	4.95	3.75	3.43	3.55	3.11
Turbine Rating	3.95	2.95	2.80	2.88	2.55
Compressor Power	2.95	1.95	1.80	1.88	1.55
Useful Output	1.00	1.00	1.00	1.00	1.00
% Eff. at 1200°F.	20.2	26.6	29.2	28.1	32.2
Gas Temp. in °F. at					
Turbine Inlet	1200	1200	1200	1200	1200
Leaving Reheater	--	--	--	1200	1200
Turbine Exhaust	635	790	695	920	865
Leaving Regenerator	--	455	350	560	520
Air Temp. in °F at					
Compressor Inlet	70	70	70	70	70
Leaving Intercooler	--	--	70	--	--
Leaving Compressor	490	340	230	440	405
Entering Combustor	490	680	575	800	750
Press. lbs/sq.in.abs at					
Compressor Inlet	14.7	14.7	14.7	14.7	14.7
Compressor Discharge	88.2	51.5	73.5	73.5	102.9
Turbine Inlet	88.2	50.2	71.7	71.7	100.4
Turbine Exhaust	14.7	15.1	15.1	15.1	15.1

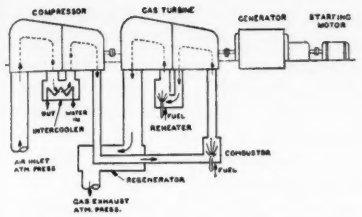


Fig. 3. Open cycle with intercool, reheat and regeneration

gard to a suitable source of cooling water.

In the gas turbine cycle, the useful power output depends upon obtaining relatively high turbine and compressor efficiency. The 750 F curve of Fig. 2 is plotted for two different compressor efficiencies, showing the effect of change in efficiency of one of the elements. The relatively low pressure ratios at which maximum efficiency is obtained, around 6 for 1200 F, means that relatively low turbine inlet pressures exist in the open cycle, under 100 psi abs. Low pressure results in large gas volume and relatively large turbine blade dimensions.

Regenerating, Intercooling and Reheating

There are three practical ways of greatly improving the gas turbine open cycle efficiency. They are: regenerating, intercooling and reheating which can be employed in various combinations. Calculations indicate that the economic size of the heat exchanger will limit the regenerating cycle, at 1200 F inlet temperature, to approximately 75 per cent recovery of the heat available from the turbine exhaust gases. This economic size will be about 0.30 cu ft of heat exchanger volume per kw of capacity.

By intercooling, the compressor work is reduced because the colder air has smaller volume. Other conditions remaining the same, one stage of intercooling will reduce the compressor work by some 15 per cent. This increases the portion of the turbine capacity available as useful output and improves

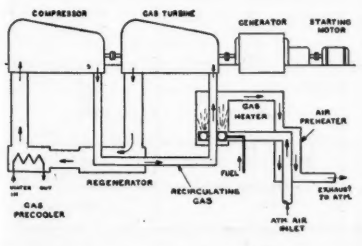


Fig. 6. Escher Wyss externally-fired closed gas turbine cycle

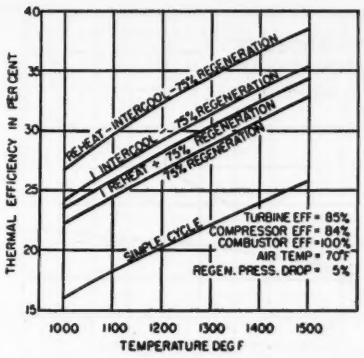

THERMAL EFFICIENCY IN PER CENT
TEMPERATURE DEG F
REHEAT - INTERCOOL - 75% REGENERATION
I INTERCOOL - 75% REGENERATION
I REHEAT - 75% REGENERATION
75% REGENERATION
SIMPLE CYCLE
TURBINE EFF = 85%
COMPRESSOR EFF = 84%
COMBUSTOR EFF = 100%
AIR TEMP = 70°F
REGEN. PRESS. DROP = 5%

Fig. 4. Effect of reheat, intercool and regeneration on thermal efficiency over range 1000 to 1500 F

the cycle efficiency. A large number of intercoolers is ideal but probably only a few stages will be practical.

The gas turbine reheat cycle is the same in principle as the reheat cycle used in many steam plants. In practice it will bear little resemblance. Reheating in the gas turbine will consist of burning fuel directly in the gas (approximately 85 per cent air) passing through the turbine. The quantity of large steam piping and considerable heat transfer surface in the heat exchanger of the steam reheat cycle will be replaced by a reheating combustor which may possibly be placed inside the gas turbine casing proper. Here again, the practical number of reheats is limited.

Various Cycle Combinations Compared

The combination of regenerating, reheating and intercooling is shown in Fig. 3 and different cycle arrangements are compared in Table I. Thermal efficiency of the open cycle gas turbine for various combinations of regenerating, reheating and intercooling is shown in Fig. 4.

Temperature of the inlet air to the compressor has a marked effect on the cycle efficiency, as in Fig. 5. In contrast to steam plants, the colder this inlet air, the higher the cycle efficiency and capacity. In

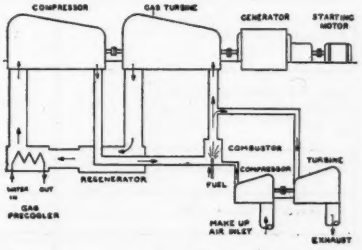


Fig. 7. Proposed Westinghouse internally-fired closed gas turbine cycle

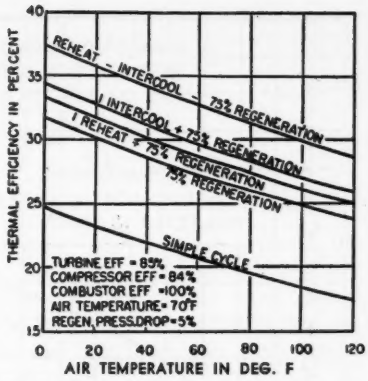

THERMAL EFFICIENCY IN PER CENT
AIR TEMPERATURE IN DEG. F
REHEAT - INTERCOOL - 75% REGENERATION
I INTERCOOL - 75% REGENERATION
I REHEAT - 75% REGENERATION
75% REGENERATION
SIMPLE CYCLE
TURBINE EFF = 85%
COMPRESSOR EFF = 84%
COMBUSTOR EFF = 100%
AIR TEMPERATURE = 70°F
REGEN. PRESS. DROP = 5%

Fig. 5. Effect of compressor inlet air temperature on thermal efficiency of open cycle gas turbine with 1200 F inlet gas temperature

the simple open cycle, changing the inlet air temperature 10 F changes the cycle efficiency 0.74 points or approximately 3 per cent per 10 F change. The effect on capacity is approximately 4 per cent per 10 F change.

Closed Cycle for Large Units

The closed gas turbine cycle offers a method of increasing the maximum capacity of the open cycle. The volume of the working gas is inversely proportional to the absolute pressure. If the pressure is multiplied by 10, the size is divided by 10. In the closed cycle, the circulating working gas is at a relatively high pressure and reduces the physical size of compressor and turbine. To reduce the temperature of the gases before they enter the compressor, cooling water is required in the closed cycle. The heat exchanger in which the gas is cooled before it enters the compressor is called a gas precooler. The amount of heat given up to the cooling water is equivalent to that removed in the condenser of a steam unit of equal capacity. The quantity of cooling water required will be less, as a higher water temperature rise is permissible.

The closed cycle of Fig. 6 is the one used by Escher Wyss. This is an externally-fired cycle, in which the products of combustion do not pass through the gas turbine and compressor. The working gas (air, hydrogen or other medium) operates at a relatively high pressure in a closed, recirculating circuit. The gas heater in this cycle corresponds to the steam boiler in the steam cycle. For a practical efficiency, it will be larger than the modern steam boiler because gases are on both sides of the gas heater. This cycle is very similar to the steam cycle, except that the work-

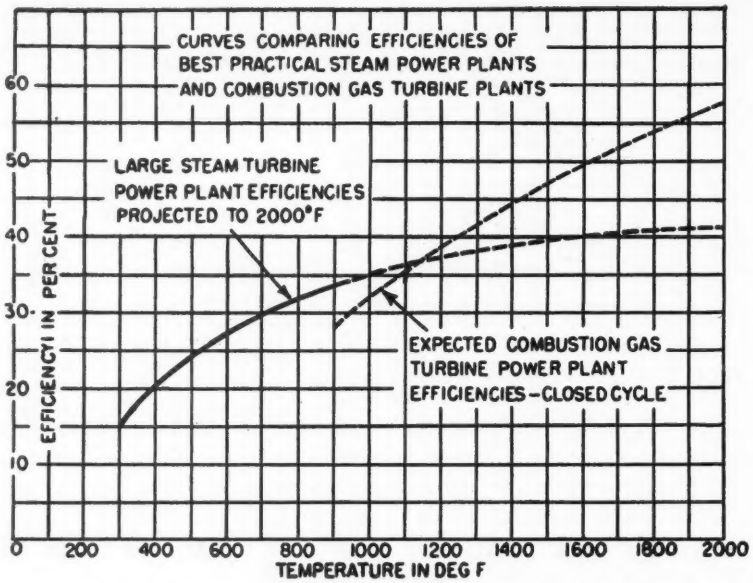


Fig. 8. Efficiencies compared for best practical steam power plants and closed cycle combustion gas turbine plants

ing fluid does not undergo a change of state. This closed cycle keeps the products of combustion out of the turbine and compressor circuit, hence the problem of using coal as a fuel should be much simpler of solution than in those cycles that circulate the products of combustion.

Hydrogen Has Advantages

In the closed cycle, the compressor inlet pressure will be maintained at approximately 150 psi with a discharge pressure of some 600 psi. This high pressure greatly reduces the size of turbine and compressor and should permit maximum ratings to be built approaching those in the steam cycle. Some gas other than air may be used as the working medium in the externally-fired closed cycle. Hydrogen, for example, has properties which make it far superior to air for this application. The density of hydrogen is 1/14 that of air, the specific heat is 14 times that of air, and the thermal conductivity is 6.8 times that of air.

New Cycle Studied

A closed cycle system under development by Westinghouse, is shown in Fig. 7. In this closed cycle a separate gas turbine and compressor are used to pump up the cycle on which the main gas turbine and compressor operate. High pressure of around 600 psi may be used, with a compressor inlet pressure of around 150 psi. The main gas turbine and compressor would be small, as they operate at high pressure. This cycle is internally fired, the products of combustion passing through the gas turbines and main compressor. Enough make-up air is continually supplied to maintain pressure and support combustion. It is supplied by a compressor driven by a second gas turbine. This cycle avoids the large gas heater required by the Escher Wyss cycle; but requires an extra gas turbine and compressor to pump up the system. Solid matter from the fuel must be removed.

In the closed cycles shown in Figs. 6 and 7, reheating and intercooling are not illustrated. However, they offer the same advantage in the closed cycle as in the open cycle. The biggest single additional problem in the closed cycle is a method of building practical heat exchangers. The problem is further complicated by the fact that the gases will carry foreign matter from combustion which may both corrode and erode the exchanger and reduce the heat transfer rate by depositing foreign material on the transfer surface.

Gas Turbine Control

Combustion gas turbine control can be simple and reliable, consisting only of control of the gas temperature by controlling the rate of fuel supply. Governing valves, such as used in steam turbine control, are not needed. Efficient partial load performance can be obtained by using two turbines: one variable speed turbine driving a compressor; plus a constant speed turbine driving a generator. The use of regenerators, reheaters and intercoolers, in addition to improving the full load economy, has an even greater effect in improving the partial load economy. In the closed cycle, by reducing the gas pressure as the load is reduced, practically full load efficiency can be maintained at partial loads.

Steam and Combustion Gas Cycles Compared

Because steam is the most widely used medium for transferring heat into mechanical energy, a comparison of the steam cycle and the gas cycle may help in judging the gas cycle and its possibilities. In judging the efficiency of power cycles, a 100 per cent thermal efficiency is not obtainable, for

Table II. Comparison of combustion gas turbine and steam turbine, 5000-kw, 3600-rpm unit

Item \ Cycle	Open Cycle Gas Turbine			Steam Turbine
	Simple Cycle	One reheat, one intercool and regeneration		3 Stages F. W. H.
	Single Cyl.	H.P. Turbine	L.P. Turbine	Single Cylinder
Inlet Pressure - lbs/sq.in.Abs. Inlet Temp. - °F.T.T. Exhaust Press. - lbs/sq.in.Abs.	88.2 1200 14.7	100.4 1200 39.4	39.4 1200 15.1	465 825 3/4
Steam or Gas rate - lbs./Kw.hr. Full Load Flow - lbs/hr.	102 510,000	56 280,000		10.5 52,500
Inlet Vol. Flow - cu.ft./sec. Exhaust Vol. Flow - cu.ft./sec. Ratio (Exhaust Vol. ÷ Inlet Vol)	990 3900 3.95	475 3250 6.85		24.8 6120 250
Turbine Floor Area - sq.ft.	160	150	155	100 (Turbine Room Only)
Net Generator Output - KW	5000	5000		5000
Approx. Plant Thermal Eff. - %	18.4*	29.4*		23.6

* Inlet Air Temp. 70°F.

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the temperature of the cold body is far above the absolute zero of temperature. The Carnot cycle is a theoretically perfect cycle, and no cycle operating between the same hot and cold body temperatures can have a better thermal efficiency. The best any cycle can hope to do, when operating under the same conditions, is to attain the Carnot cycle efficiency. The gas turbine cycle can theoretically give the same efficiency as the Carnot cycle. This is only theoretically possible, because it requires 100 per cent efficiency of the gas turbine and compressor, an infinite number of stages of intercooling and reheating, and a regenerator infinite in size.

The steam cycle theoretically offers the Carnot cycle efficiency only up to the critical pressure (705.4 F; 3206 psi abs). Above this temperature, the gap between the steam cycle and the ideal cycle gradually widens as the temperature is increased. From a purely theoretical standpoint the combustion gas turbine cycle holds forth greater promise of efficiency than the steam cycle.

Gas Cycle Holds Best Promise

Of more value are the thermal efficiencies obtainable in practical applications. Figure 8 compares the best efficiencies obtained in large central station power plants (projected to 2000 F) with the expected practical limit in efficiency of the large-capacity, closed-cycle combustion gas turbine power plants. Above 1000 F, the gas cycle efficiency increases approximately three times as fast as the steam cycle efficiency for a given top temperature increase.

This curve compares the best modern large central station steam power plants with the best practical efficiencies expected of the combustion gas turbine power plants. It is expected that the gas turbine cycle efficiency will not be greatly affected by unit size, and this combustion gas cycle curve can also be interpreted as applying to open cycle gas turbine power plants of relatively small capacity. Economic steam plants for capacities around 5000 kw seldom exceed 25 per cent overall thermal efficiency. This would indicate a considerable efficiency advantage, in small units, in favor of the gas cycle, provided economics permit designing it for anywhere near its maximum possible efficiency.

Typical Steam and Gas Units

A 3600-rpm, 5000-kw steam turbine is compared with a 3600-rpm, 5000-kw net output open cycle gas turbine in Table II. This comparison indicates the low pressure in the open cycle gas turbine as compared with the steam cycle. As a result, the energy per pound of gas is small and the flow of gas is very large; 510,000 lb per hr for the simple cycle gas turbine as compared to 52,500 lb per hr of steam to the steam turbine. The large flow and low pressure to the inlet of the gas turbine gives a large volume flow which means the piping and blading of the gas turbine inlet are large compared to the steam turbine.

The ratio of exhaust to inlet volume is small for the gas turbine. This makes a balanced blade path unlike that of the steam turbine, which in this case must handle an exhaust volume 250 times as great as the inlet volume. The large blade dimensions limits the maximum net output rating of the open cycle, single flow, combustion gas turbine to approximately 7500 kw. However, the injection of liquids presents a theoretical possibility considerably extending this limit.

As indicated in Table III, the possible applications of the gas turbine are many, ranging from a simple open cycle for small capacities to a closed cycle for very large ratings.

Many Problems Ahead

In drawing conclusions, it should be remembered that the cycle has only had practical application in very special cases. The full possibilities of any cycle can only be evaluated from successful proof of its economy, first cost, maintenance cost and reliability. The addition of elements which improve the fuel economy, and arrangements of the cycle for large capacities, are obtained at a sacrifice in simplicity and at a price. The development of the best system is expected to be costly in time and money.

Metallurgy plays an important part in the gas cycle as the efficiency increases rapidly with increase in top temperature. To obtain materials suitable for operation at higher temperatures, the metallurgists are looking at materials similar to the non-forgable and non-machinable tool steels. The method of forming these alloys to shape, such as precision casting to size, may revolutionize accepted methods of manufacture. To apply such materials, their additional first cost and manufacturing cost must be justified. Any application of such materials must be preceded by careful tests. For heavy duty apparatus these tests must extend

(*Continued on page* 150)

Table III. Possible combustion gas turbine applications

Industry	Application	Possible Fuel	Comments
1. AVIATION	(a) Jet Propulsion (b) Booster for piston engine (c) Propeller drive (Geared or electric)	Gasoline Kerosene	The small, lightweight, gas turbine appears to have a bright future in aviation because of the tendency toward power requirements beyond the practical maximum for piston engines. Much work has been done the world over, burning gasoline and kerosene.
2. RAILROAD	(a) Locomotive (electric or geared drive)	Coal, Bunker "C" oil, or Diesel oil	One of the biggest problems in this field is combustion. First, Diesel oil, later Bunker "C" oil, and ultimately coal must be burned. Electric drive promising. Geared drive presents special problems because of the reversing requirement.*
3. MARINE	(a) Marine vessels (Electric or geared drive)	Diesel oil or Bunker "C" oil	Possible Diesel oil burning turbine electric propulsion equipment will pioneer. The geared drive will follow when reversing and other problems have been worked out.*
4. CENTRAL STATION	(a) Fully automatic booster station at end of transmission line. (b) Standby plant for hydro installation. (c) Standby or Peak Load plant for small system. (d) In locations where water is not available.	Diesel oil, Bunker "C" oil or coal	The development of the gas turbine in the central station field will probably start along the lines of intermittent duty applications such as (a), (b), or (c) and may culminate in plants for continuous operation.*
5. INDUSTRIAL	(a) By-product power (b) Standby plant to steam or purchased power where power shutdown is disastrous. (c) Main power source for seasonal industries. (d) Peak load plant, supplementing steam or purchased power. (e) Main power source in low use factor applications such as large laboratories (f) In a two fluid cycle with one objective, the generation of process steam	Diesel oil, Bunker "C" oil or coal	Probably continue present developments for operation in conjunction with Processes for oil refining.
6. SPECIAL	(a) Bombproof power plants.	Diesel Oil or Bunker "C" oil	A 4000 kw plant of this type was built at Neuchatel, Switzerland, in 1939. The fact that no condensing water is required makes the gas turbine ideal for such applications.

* For applications such as 2,3,4 and 5, it may sometimes be desirable to depart from the single shaft arrangement and utilize a two shaft arrangement in which the compressor is driven by one turbine while a separate turbine drives the generator or other apparatus.

Diesels of New Design by Hendy

Modern features characterize new series Diesels designed for stationary and marine service . . . Distinctly new cylinder-head assembly . . . Unit type fuel pumps and injectors . . . Efficiency and simplicity predominating objectives in new 4-cylinder design

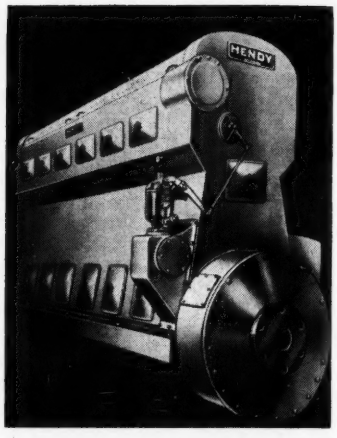

Fig. 1. Exterior view of new Hendy Diesel engine for stationary or marine use

DESIGN features of the new Series 50 Diesels recently introduced by Joshua Hendy Iron Works bring into one model a wide range of modern features which years of research and development by Hendy engineers have proved to be desirable in stationary and marine Diesel engines. Among these features are the cylinder-head assembly, unit type fuel pumps and injectors combined with overhead camshaft, and valve and rocker-arm design to insure valve seating without side thrust on the valve stems. This new series is of 4-cycle design, with 12-in. bore and 15-in. stroke, normally rated at 83.3 hp per cylinder at 500 rpm.

The use of unit fuel injectors in each cylinder permit short fuel lines, higher pressures which improve atomization are thus possible. The entire pump and nozzle unit can be quickly and easily removed for cleaning, if necessary.

Efficiency is further advanced by the use of dual alloy-steel intake and exhaust valves. Smaller valve diameters and closer volumetric control are achieved with the dual valves. Valves operate at lower temperatures, which increases their service lift and saves grinding. The large valve area reduces velocity through the openings and further reduces valve maintenance. The valves operate in removable guides.

Heads are cast from Meehanite with large water passages for cooling of valve guides, injector, and valves. Dead-water spaces are eliminated by jet action which directs cooling water to points of highest potential temperature.

Valve Mechanism

Rocker arms bear on positive acting, slotted cross heads or dividers so that pressure is evenly distributed on the dual intake and exhaust valves and side thrust is eliminated. This helps insure positive seating and increases the life of valve stems and guides. Valve action is further controlled by hydraulic tappets that automatically take up clearance so that the action is quiet and positive.

An integral feature of the head-assembly design is the overhead camshaft, which results in a rigid, positive valve action. The camshaft is 3 in. diam ground steel, and is fitted with forged and case-hardened steel cams, keyed to shaft. Camshaft bearings are force-feed lubricated through drilled holes. In reversing-type engines the camshaft is moved axially by a pneumatic cylinder.

Both engine bed and cylinder block are of welded steel construction. The heavily ribbed, deep sections of the bed provide extreme rigidity for crankshaft bearings.

The cylinder block is of similar construction, with circulating water confined to the removable cylinder liner by use of jackets on each liner; thus none of the cooling water is in contact with the block. The cooling water enters each cylinder jacket from a header and is so controlled that high velocity is obtained at the top of the liner before it enters the cylinder head. The head is so cored that the main water volume gains a jet action around the injector, to keep the nozzle cool and reduce carbon deposits.

On marine models, reversible-type centrifugal pumps circulate raw and fresh cooling waters. Tube-type cooling-water heat exchangers, with fresh and raw water pumps and complete piping, are integral parts of these Diesels. In this way salt-water corrosion is eliminated and more-efficient operating temperatures are maintained. The water-cooled exhaust manifolds on both marine and stationary types are fabricated from welded steel

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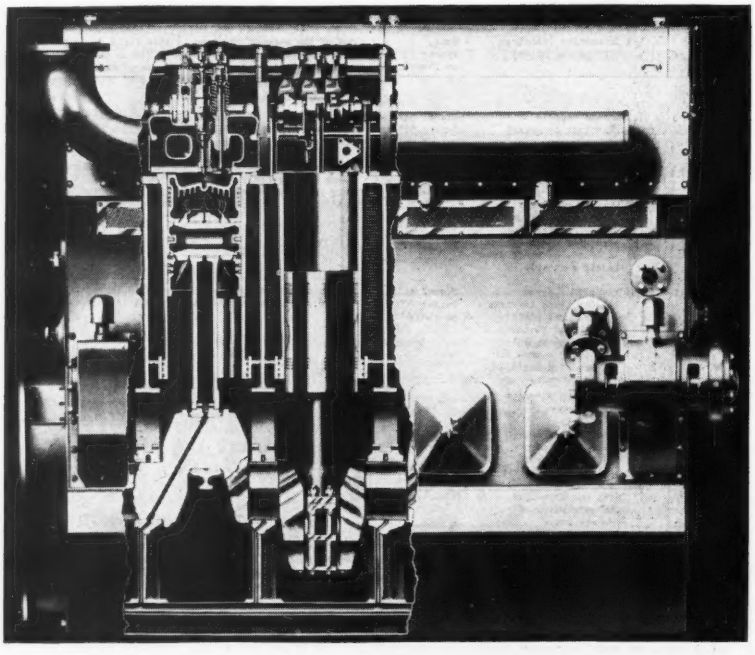


Fig. 2. Cross-section, side view, cut-away illustrating details of construction

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Thanks for the Small Plant Dope

Last month's appeal for material on small plants brought most excellent results. A number of readers submitted complete articles dealing with various problems of small plant operation while many others commented on the subject in letters. All of these will be published in future issues.

One of the most interesting of the articles received, is one by R. L. Brown of Sloat, Calif. In submitting his article, Mr. Brown is dubious about its being of interest to others but he says he is willing to let us be the judge of that. "It happens to be part of a chapter out of my life," he writes " . . . while I was working my way up to the job of being Chief Engineer."

The thing we like best about Mr. Brown's article is its sincerity. He tells the story exactly as it happened—nothing very exciting, perhaps, but full of the trials and tribulations of the life of an engineer in a small, primitive power plant. It is a story of hard work, of long, painstaking effort to keep a "bunch of junk" running despite all the usual indifference of the owners who took the engineer's work for granted. Many engineers, who read Mr. Brown's article when it is published, will find in it a reflection of their own experiences, and for that reason they will find it interesting. They will understand how difficult it was to realign and revamp the old engine Mr. Brown tells about; what it meant to do all this work without the proper tools, without even a lathe or a jig with which to bore the bearings.

We don't want to tell the whole story here but can assure you that you will find it interesting when it appears. Mr. Brown says he still has lots to learn after 20 years in the power plant game and that he would like to read about the experiences of others, no matter how small the plant or the operation.

A. W. K.

CONTENTS

Why Do Solid Masonry Boiler Walls Fail? 104
By George P. Reintjes

For the Plant Electrician 107
Facts About Battery Dopes
Division of Research, National Better-Business Bureau
It's An Ejector
By Guillermo Pablo
Protective Sleeve Prevents Spatter in Dip-Soldering

Letters and Comments 109
On Hiring New Men
Takes Issue with Robert Baker
But It Did Work
Maybe He Knew Something About NH_3
Engineer Must Prove His Worth
Men of Mechanical Might
It Might Have Been Worse
Improving the Operating Engineer's Status
More About $1500 Men

How Would You Do It? 112
Problem 33. Regulating Sulphuric Acid Feed
Problem 34. The Case of the Dirty Lantern

Questions and Answers 118
Does Saturated or Superheated Steam Give Higher Heat Transmission?
How Prevent Spontaneous Combustion of Coal in Silos and Bins?
Can He Use Induction Heating on This Job?
The Last of the Broken Anchor Bolt
How Can Boiler Operation Be Improved?
How Stop Fuel Waste in This Unit Heater System?
What Will Happen to the Megavars—and Why?

Formulas for Determining Current in A-C Circuits 126

A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE

Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Why Do Solid Masonry Boiler Walls Fail?

In the January issue, on page 100, a reader, who signed himself R. J. R., asked why the setting under his HRT boiler cracked and bulged. In the March issue we presented several answers to this question, but we felt it deserved further attention so we asked Mr. Reintjes if he would discuss the subject in a longer article. This is the result of this request. Mr. Reintjes covers all aspects of the problem of providing proper settings and we believe his discussion will be of interest and value to all boiler operators

By GEORGE P. REINTJES

President, Geo. P. Reintjes Company, Kansas City, Mo.

WHY DO solid masonry walls of a boiler furnace fail? That is an age-old question. To the one experienced in the construction of this type of boiler heat enclosure, there is no hard and fast answer for the failure of such construction, but the fact still remains that such furnaces fail all too frequently. In fact, the difficulties inherent in this type of construction have led to its abandonment in most settings for larger power and heating boilers.

But R. J. R. has a battery setting consisting of two HRT boilers with solid masonry settings which have shown signs of distress after a very short period of operation. He wants to know why these particular settings failed and what steps he can take to insure that such an occurrence will not be repeated. It is exceedingly difficult to tell just why R. J. R.'s particular installation failed, because he has not included information regarding many of the things which an experienced boiler furnace setter wants to know. He tells us nothing about the foundation conditions under the battery setting, whether or not insulating brick were used in the construction of the furnace wall, the extent of the buck-staying used, the expansion provisions between the boiler shell and the furnace walls, and whether or not any provision was made for expansion in the solid masonry settings. And to make the problem just a little more difficult, nothing is said as to whether the masons who laid up the walls had sufficient solid masonry furnace wall experience.

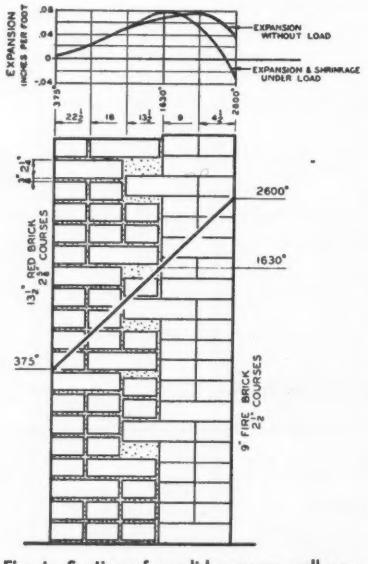


Fig. 1. Section of a solid masonry wall consisting of a 9-in. fire brick and 13½-in. red brick backing

In view of these conditions, it is difficult, indeed, to make any intelligent analysis of the reason why these particular settings developed difficulties so rapidly. One can only guess at reasons for the failure, and guessing is rather an outmoded vocation for the engineer or construction man working with boilers. Since this is the case, it is much better to attempt to give R. J. R. some assistance in planning for the elimination of future furnace failure, rather than trying to guess at the reason for the difficulty with the present settings.

Behavior of Materials

In order to understand the behavior of solid masonry walls, it is necessary to know something about the behavior of fire brick, mortar, and red brick when subjected to high temperatures.

When brick is heated it expands until its temperature approaches the softening point. As this temperature is neared the brick begins to shrink. The temperature at which the softening and subsequent contraction occurs is determined by the load carried on the brick. As this load is increased, the temperature at which contraction begins is decreased.

For purposes of illustration, consider the solid masonry wall shown in Fig. 1 consisting of a 9-in. fire brick and 13½-in. red brick backing. It is the usual practice to bond red brick and fire brick every fifth course. When the fire brick and red brick are of different thicknesses or the two kinds of brick are not laid in uniform level courses, it becomes necessary to take up the inequality with thick mortar joints at the bonding points. This hit and miss bonding produces the fewest cracks in the outside wall because the thick mortar joints in the bonding area soon disintegrate due to the temperature in this zone and the fire brick lining is free to expand and contract independent of the red brick facing. This produces two independent walls which may or may not be stable when the boiler is in operation.

With a furnace temperature of 2600 F, the outside wall temperature will be approximately 375 F. The mortar between the red brick joints varies in temperature from 375 F at the exterior wall face to as much as 1630 F adjoining the fire brick. Cement mortar starts dehydrating at approximately 400 F and is completely dehydrated at 900 F. As a consequence, the cement of the mortar in the center of the wall will be completely disintegrated after the boiler has been in operation only a short time. Lime used in this red brick mortar also breaks down under these temperature conditions. It's a safe rule NEVER to expose red brick and cement or lime mortars to temperatures exceeding 800 F.

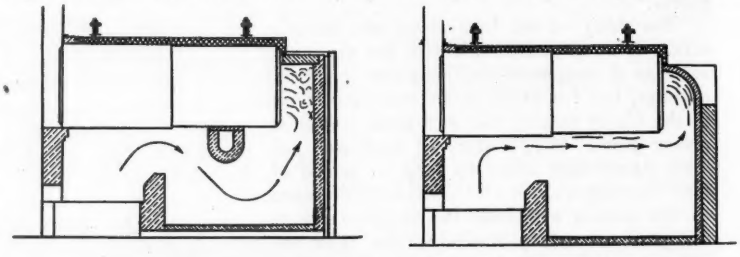


Fig. 2. Sections showing two types of rear arch construction

Provisions for Expansion Necessary

Suitable provisions to compensate for the expansion of both the boiler shell and the furnace refractories must be incorporated in the heat enclosure to ensure trouble-free operation. For example, the HRT boiler shell may expand from ¾-in. to 1¼-in. in length and from ⅜-in. to ⅝-in. in diam, depending upon the dimensions of the shell and the temperature rise to which it is subjected. The expansion of the refractories in the walls will vary considerably due to the wide range in temperature to which the various portions of the setting are subjected, being as great as ⅛-in. per ft in some instances.

The enclosure must be designed to absorb the expansion of the boiler shell without either damage to it or the formation of cracks which allow excessive air leakage into the furnace and con-

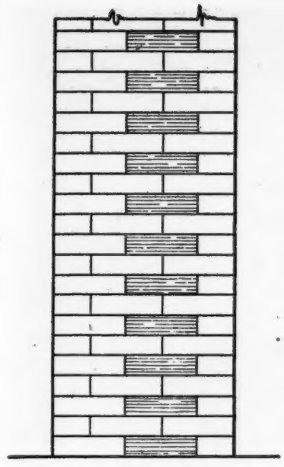


Fig. 3. A solid masonry wall using fire brick for the entire wall laying the brick with the English bond

sequently lowered boiler efficiency. Another complication is introduced because the upper half of the boiler shell projects above the enclosure. Added to these is the problem of horizontal expansion in the enclosure, which must be relatively long for a given boiler capacity. For example, the outside length of the setting for a 150 hp boiler may be as much as 27 to 28 ft.

Foundations

Many boiler setting failures, particularly when solid walls are employed, have been attributed to the disintegration of the foundation resulting from the drying out and subsequent shrinking of the soil beneath. Heat penetration through the uncooled floor of a furnace has been known to dry out the soil for a depth of 15 ft below it. This heat penetration and subsequent soil drying can be prevented by the use of an air-cooled furnace floor.

BUCKSTAYS. The solid masonry setting should be equipped with adequate buckstays. In some instances the buckstays provided are inadequate; in others they have been omitted entirely since there was insufficient space for their installation in the area available for the boiler. Where the available boiler space is limited, the boiler columns are generally encased in the solid walls. When this is done, oxidation and corrosion of the columns invariably follows and eventually the columns are corroded to such an extent that they fail to support the weight of the boiler.

Since the HRT boiler is a relatively low cost boiler designed for operation at the low steam pressures employed for heating purposes, and for low-pressure power requirements, the idea that every part of the installation should be the cheapest possible construction has gained such momentum that cheapness has become a cardinal law in the minds of many charged with the installation and operation of this type boiler. This is indeed unfortunate. Unfortunate because often the cheapest initial construction is the most costly of luxuries when due consideration is given to maintenance and operating efficiency.

Too seldom has much consideration been given to the use of the better types of heat enclosures with HRT boilers, and the reason is obvious. The initial cost of a good furnace setting is often twice as much as the cost of the boiler. This high cost is due to the fact that the HRT boiler requires from 3 to 4 sq ft of wall per boiler hp while the water-tube boiler will only need about one-half as much wall area per boiler hp. At the outset, therefore, the furnace is much larger for an HRT boiler than it is for a water-tube boiler of comparable horsepower rating.

A suitable furnace for any boiler, regardless of type, must fulfill certain requirements dictated by the laws of proper fuel combustion. It must have adequate volume to insure that all of the fuel is burned. As the volatiles are driven off from the coal being burned, they must be kept at a sufficient temperature to maintain combustion. While the ignition temperature for the volatiles from coal as well as gas and oil fuels ranges from 1000 to 1200 F, actually it is advisable to maintain the temperature in the furnace at a value well above this range to insure firing. It is generally considered that the lower furnace temperature limit is 1500 F, although temperatures above this value are advisable. Where the flame impinges on the lower surface of the boiler shell, however, the gases may be chilled to a temperature considerably below the ignition point. The reason for this is readily apparent when the temperatures inside the boiler are considered. With a boiler operating at 100 psi gage, the temperature of the steam is 338 F, and the temperature of the lower portion of the boiler shell is probably under 350 F.

Whenever the temperature of unburned volatiles in the fuel is reduced to a value below the kindling temperature, they will not burn. Unless they can subsequently be brought to a temperature above the kindling point, they pass out of the boiler in an unburned state and the heat which they would have produced is lost. As a result, it is necessary to design the furnace in such a manner that the flame does not touch the boiler shell.

Another important feature in the construction of a suitable heat enclosure is the correct shape for the arch at the rear of the boiler, Fig. 2. Where a curved arch is used, the tendency is to deflect the hot gases away from the lower row of tubes. This results in such low gas velocities through the lower

"That's final, Murchison—I positively will not fire you!"

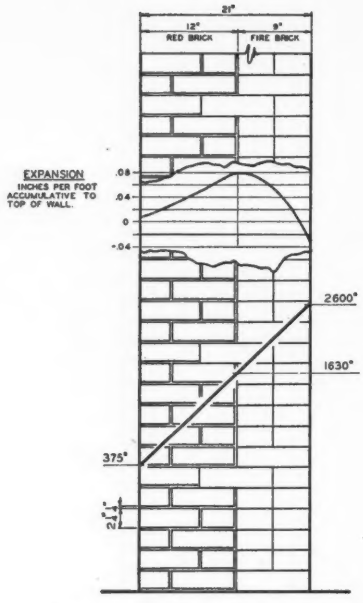


Fig. 4. Temperature gradient and expansion of solid walls

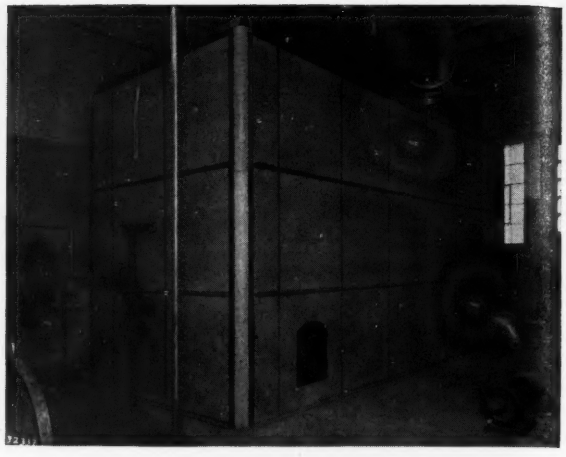


Fig. 6. A sectionally supported wall enclosure with asbestos lumber casing

tube rows that they soon fill up with soot and ash and the upper rows of tubes are the only ones which are effective. On the other hand, the use of a flat arch and a rectangularly-shaped gas passage produce eddying of the gases which assists in distributing them so that all tube rows receive a proportionate share of the hot gases. Tubes do not plug up, and the boiler capacity is maintained at a higher value than is possible with a curved arch.

Better Furnace Construction

The most practical construction for a solid masonry wall is to use fire brick for the entire wall, laying the brick with the English bond, Fig. 3. This provides a header course every other course thereby ensuring three times as many brick ties as are possible in the construction shown in Fig. 1. Every few feet of wall height the outer course of brick should be laid without mortar, and preferably with paper placed between the brick courses to prevent the bonding of the brick at these joints. This provides predetermined horizontal cracks and separations in the wall which assist in relieving the strain on the inner tie brick when the furnace is hot.

When the solid fire brick wall is not considered desirable, and it is felt that the combination fire brick and red brick should be used, then it is necessary to use a red brick which does not exceed 2¼-in. thickness. Furthermore, the mortar joints in the red brick should not exceed ¼-in. This construction, shown by Fig. 4, provides the necessary level courses and ensures a thorough bonding between the two dissimilar types of brick. Provisions must be made, however, to ensure that the mortar is not robbed of water too rapidly by the red brick or the joints will not set up properly.

While sufficient buckstays should be used in the construction of the solid masonry wall, such buckstaying can only prevent crawling or twisting of the outside wall surface. Any inward movement on the inside furnace wall will occur with a HRT boiler, because a solid wall provides no means available to prevent it.

Solid masonry walls have failed to give satisfactory service in many instances. On the other hand, the sectionally-supported construction, Fig. 5, due to its inherently superior performance, will reduce maintenance costs, maintain boiler efficiency, and prolong the life of the enclosure. In spite of its higher initial cost, the sectionally-supported heat enclosure can effect real savings for the boiler operator.

Sectionally-Supported Walls

The sectionally-supported wall construction, due to its ability to absorb the expansion of both boiler and refractories without cracking or deforming, will in many instances outlast the boiler. It can be used on an existing boiler regardless of boiler age or condition. When the existing boiler must be replaced, it is

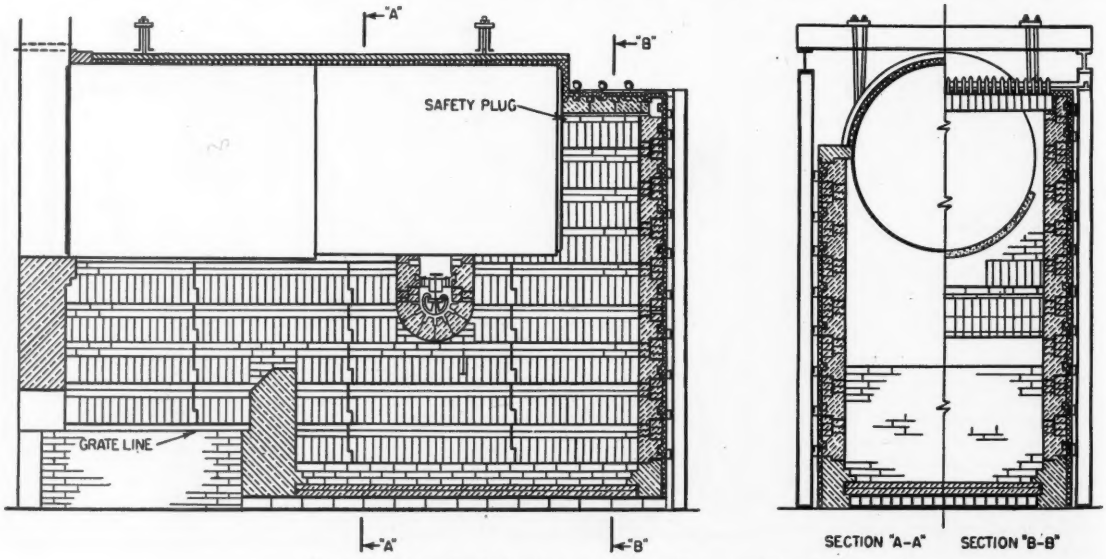


Fig. 5. HRT longitudinal and cross section, with supported walls

not necessary to dismantle the sectionally-supported enclosure, since the old boiler can be removed and a new boiler installed without taking down the enclosure. Because HRT boilers of a given horsepower capacity are practically the same size regardless of manufacture, any make of boiler will fit the enclosure.

A drop nosing installed in the enclosure behind the bridge wall deflects the hot gases downward and away from the rear lower surface of the boiler shell. The blowoff line is protected from the hot gases by a diamond-shaped pier which performs the further function of creating turbulence in the gases thereby preventing stratification.

Generally the use of supported walls permits the reduction of the overall width of the furnace approximately 18-in. Furthermore, an air-cooled furnace bottom can be easily installed by the use of hollow tile, as shown in Fig. 5. This air-cooled floor permits preheating of the combustion air which can be arranged for operation with either natural or forced draft.

Although the sectionally-supported heat enclosure has received scant consideration for application to HRT boilers in the past because the initial cost of the enclosure was not cheap, the operator of the boiler has often been forced to spend more money for fuel, maintenance, and the original cheap wall installation than he would have had to spend if he had insisted upon the more expensive investment in a sectionally-supported heat enclosure which would materially reduce his maintenance costs while saving him fuel.

Note how the sectionally-supported walls are divided into a series of units, each unit being entirely independent of any other unit. Note how the supported wall steel supports the boiler shell and eliminates the use of boiler supporting columns. A cross beam atop the wall steel gives adjustability to the drum supporting girder; thus, regardless of the location of the supported lugs on the boiler, the wall steel will support the drum.

Figure 6 shows a sectionally-supported wall enclosure with asbestos lumber casing. Drum girder supports are clearly shown.

FOR THE PLANT ELECTRICIAN

Facts About Battery Dopes

Compiled by the Division of Research, National Better-Business Bureau

Battery manufacturers do not put any special "dopes" in their batteries. Why? Because tests have demonstrated that these compounds are either useless or harmful.

These are the two chief reasons cited by over sixty battery manufacturers who recently were questioned on the subject in a nation-wide survey conducted by the National Better Business Bureau. Battery manufacturers have made hundreds of tests on various chemicals that have been sold as panaceas for battery failure, but as one manufacturer put it:

"To date there has been nothing found which can be added to the electrolyte of a storage battery which will facilitate charging or increase the life of a storage battery. Battery dopes are either harmful to the life of a storage battery or have no material effect either on the life or on the charge of a battery. However, those compounds which are not harmful increase the inert material in the electrolyte and in this respect are harmful."

Debunking Claims for "Dopes"

Chief claim made for battery dopes is that by dissolving the hardened sulphate on battery plates they keep good batteries in first class shape and restore new life to sick ones. According to authorities on the subject, the lead sulphate which forms on battery plates is only sparingly soluble. It can be removed from lead plates adequately only by a charge of electric energy. No battery "dope" contains any electric energy. No battery "dope" has been found useful in aiding battery performance.

No Beneficial Effects —says National Bureau of Standards

The highest impartial scientific authority in the United States on storage batteries is the National Bureau of Standards, official testing agency for government departments. This is what its director, Dr. Lyman J. Briggs, recently said about battery dopes:

"For the most part these (battery) compounds and solutions have as principal ingredients either or both magnesium sulphate (epsom salts) and sodium sulphate (Glauber's salt). In various samples other constituents were indicated, including: aluminum sulphate, potassium sulphate, ammonium sulphate, several kinds of alum, glycerine, chromates, phosphates, sulphuric acid, salts or copper and iron, and organic coloring agents. Whatever effect these materials may have in a storage battery when added to the standard electrolyte for such batteries, this Bureau has never found any evidence that they affect the fundamental electrochemical reactions which occur in the battery when it is charged or discharged.

"Occasionally automotive batteries may need a supplementary charge from an external source of power. This is usually evidence of some maladjustment of the operating conditions. These 'charges' are naturally a source of inconvenience and may be misunderstood by the nontechnical public. Too often these compounds are advertised with claims that the necessity for such charges is eliminated. In any case the supplementary charge, amounting to 100 to 150 amp hr, is emphasized, forgetting that the generator on the car supplies several thousand amp hr to the battery in the course of a year. Advertising leaflets accompanying these compounds are usually careful to specify that the battery and the charging system on the car must be in mechanically good condition before using the material. If this were not so, the shortcomings of the panacea would speedily become apparent.

"It is, of course, possible that some material may eventually be found which would relieve the difficulties arising from abnormal operation of storage batteries, but none of the exploited materials which have been tested have had any such merits. Compounds of epsom salts and analogous materials under a seemingly endless variety of trade names, indicating their intended application to batteries, have come and gone without attaining any permanent acceptance by the public or the battery industry.

"Advertising leaflets which accompany these compounds often deal in generalities and make few specific claims the correctness of which could be determined without long and expensive tests. Sometimes, simple 'practical tests' are described which may lead to false conclusions by those who are not familiar with the technical aspects of the subject. The ordinary user, of course, cannot compare the efficiencies of similar batteries treated with the material and others not so treated, nor can he determine whether the material extends the useful life of his battery. Carefully controlled tests are necessary in order to determine these points definitely and *none of these materials which have been tested here have produced any beneficial effect when added to the regular electrolyte. Some are definitely harmful.*"

Use Voids Factory Guarantee

Battery manufacturers generally sell their products with a standard warranty or guarantee against failure caused by manufacturing defects. This guarantee is voided, manufacturers informed the National Better Business Bureau, by the introduction of any battery dope into their batteries. The reason for this is that many battery compounds contain impurities which are definitely harmful to batteries. Naturally, manufacturers decline any responsibility for damage caused by tinkering with the original electrolyte.

No "Dopes" for Uncle Sam

If these trick compounds that are offered to the public served any useful purpose it is obvious that they would be purchased in large quantities for use in submarines, tanks, jeeps and every other vehicle utilizing storage batteries. Both the War Department and the Navy Department have reported that no special compounds or solutions are employed in

any batteries used by the Armed Forces.

Drug Store Magic

Many chemicals have been used as battery "dopes" ranging from a .01 per cent solution of an organic dye in water to pure sulphuric acid. One of the most popular compounds used through the years has been magnesium sulphate which is better known to the public as epsom salts. Three ounce packages of epsom salts, when sold as a battery "dope," command $1.50. When bought in the drug store, epsom salts sells for 20 cents per 16-oz package. In large quantities epsom salts can be purchased at wholesale for 2 cents per lb. Its sale at the rate of $8.00 per lb as a scientific battery compound has its magical aspects, but authorities consulted by this Bureau are unanimous in declaring that epsom salts, either alone or with any other ingredients, does not aid battery performance.

Trick Tests and Testimonials

Most vendors of battery "dope" can "prove" before your eyes that their magical powders or solutions perform as claimed. They also have letters of endorsement from users who testify that their product is useful. Don't be taken in by "trick" tests or incompetent testimony!

Any battery can be made to *appear* to be discharged by holding the foot on the starter until it no longer will start the motor. This does not necessarily mean that the battery *is* completely discharged. The "dope" is then inserted in the battery and it may be permitted to stand idle for a short while, or the car may be cranked by hand and the motor idled for a few minutes. A foot then is placed on the starter and presto—the motor starts. The battery would do exactly the same thing under the same circumstances if no dope were added. The test proves only that a battery run-down in this manner quickly will recuperate enough to start a motor. As for lay testimonials, they are no more reliable or acceptable today on battery dopes than they are on any other product that is evaluated in the absence of scientific yardsticks and procedures.

It needs only common sense to understand that if battery dopes were as good and as effective in increasing battery life and usefulness as the purveyors of these dopes say they are, the storage battery manufacturers would use and recommend them.

Conserve Your Battery
—and help the war effort

Tire and gas rationing is tough on your battery because it needs a minimum of recharging by the car's generator to replace the relatively large expenditure of electric energy utilized when a car is driven only a few miles a week. Your battery may run down. If so, let your service station dealer recharge it. That is the only way you can put it back into serviceable condition. Don't seek short cuts. Don't be a "dope" yourself by expecting a "dope" to work miracles for you. When any compound is discovered that will improve on the standard battery electrolyte of water and sulphuric acid, it will be in the battery the day you buy it!

It's An Ejector

By GUILLERMO PABLO

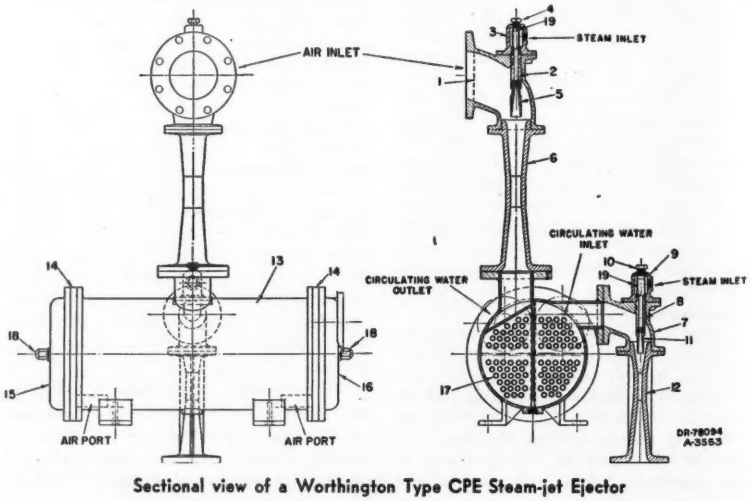
THE MEMBERS of the Power Department were discussing some of their problems at their regular weekly meeting.

"We had a funny one on that new ship today," said Jerry Gould, "the boys couldn't get up a vacuum. The construction gang had had no trouble but when the crew took over they had plenty. Seems like the air ejector wouldn't work. They finally got it to going after someone discovered that the gland sealing water had not been turned on. The chief was an old sea dog but he probably did not know too much about these new turbine jobs. I would like to see inside of one of these ejectors myself; maybe I could get a better idea of how they work. Pete, did you ever have one of those things when you were at sea?

"Yes," Pete answered, "there is not much to them, a bunch of tubes inside a casing and the steam goes in and so does the air; the thing is a sort of condenser arrangement; there are usually two stages. Believe me, they can get plenty hot when they don't work. The second stage always seems to put them over. They pull a good vacuum when they work right. Harry here ought to be able to tell us something, what about it, Harry?

"Now, you fellows know I was never at sea," Harry replied, "and I don't know how they look on board ship. However I feel in a talking mood tonight and might as well talk about air ejectors as anything else. Let's not get technical, just get the principal of the thing. The first one I ever had anything to do with was called an injector. Quiet please, don't try to tell me I am off the subject. This mechanism had a steam nozzle and close in front of it a ventura tube, the whole surrounded by a suitable casing. Leading from the annular space surrounding the nozzle and tube was a pipe leading down to the water in a tank. From the casing leading away from the ventura tube was a pipe connected to the boiler. On the way were a couple of ells and a check valve and a shutoff valve, also a drain opening with a check in it. The nozzle was suitably connected to the steam side of the boiler. When the steam was turned on it issued at high speed from the nozzle through the ventura and out the drain pipe. The air in the annular space was caught and carried along with the steam. The air being ejected until the pressure in the tail pipe was less than the atmospheric pressure, when the water was pushed up to encounter the steam, the steam condensed and the resulting hot water closed the check in the drain; then it passed through the pipe and check valve and, presto, it was in the boiler. This action took place because the potential energy of the steam was changed to kinetic energy or energy of motion. The water just got to going so fast that it opened the check valve and there it was in a nice quiet spot in the boiler. So we have the analogy of movement where there should be a state of equilibrium. That is, we have 100 lb inside and 100 lb outside yet the water moves from one side to the other. Well, so much for that. What I wanted to get over was that this thing was an E-jector, that is, threw the air out before it was an INjector; that is, threw the water in.

"Now, when the boys got to building the big turbines with their immense volumes of steam, the old reciprocating air pumps did not fit in the picture very well. So they tried this steam ejector. Obviously, they couldn't blow the steam and air out into the open, so they put a condenser behind it. That was better. The steam was condensed and returned to the system and the air passed out through a check valve. This arrangement, however, had a very small margin of reliability. The condenser on the ejector would get hot, the steam woudn't condense and the thing would vapor bind. So the next step was to put a second ejector on the first ejector's condenser. The second ejector



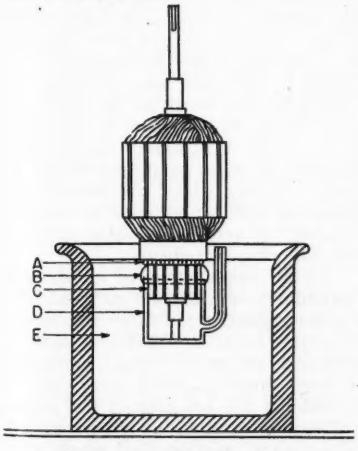
Sectional view of a Worthington Type CPE Steam-jet Ejector

has its condenser. The second ejector's job is to keep the first condenser under less than atmospheric pressure, which it does very nicely and the first can keep cool enough so it won't vapor bind. It effectively keeps the main condenser free of air—makes everything all hunky dory. Evidently, Jerry, the gang, trying to operate with the glands open, were trying to pull a vacuum on all out doors. Well, it was a good trick if it had worked. Maybe the ejector they had was not big enough. Offhand, I would say it should have been at least three times as large. You want to see the inside of one, Jerry? Well, you won't see much. Regardless of the shape of the outside casing, the guts of the thing is just this nozzle with its ventura tube. We have many applications of it and a great many forms. It is used by the steam jet refrigerator people. The Mrs. got one with her washing machine. She attaches it to the hydrant and drops the tail hose in the tub, then opens the hydrant. The high velocity water jet through the nozzle pulls the water out of the tub. Well, fellows, I must be getting along or I will be late to work."

Ed. Note: To show Jerry what the inside of one looks like, we show the accompanying sectional views of a Worthington type CPE steam-jet ejector.

Protective Sleeve Prevents Spatter in Dip-Soldering

A SIMPLE but effective protective sleeve devised by Donald Butter, a plant engineer at General Electric's Schenectady Works, prevents molten solder from spattering on the operator or adhering to the body of the commutator or shaft when dip-soldering leads of small generator rotors into the slots of the commutator segments.



A - Commutator leads to be soldered
B - Friction Tape Seal
C - Commutator
D - Protecting Sleeve
E - Solder

The sleeve consists of a cup formed of thin sheet steel with welded joints. A piece of ¼-in. standard pipe inserted and welded into the side of the cup near the bottom extends up along the outside to a point high enough above the cup so that it protrudes above the solder when the commutator is submerged. The pipe acts as a vent to carry off any steam or vapor that may generate when cold metal is submerged in the molten solder.

The cup is made with a slide fit so that it may be assembled on the commutator snugly, but without bending. It covers the shaft end and about three-quarters of the commutator body. The joint between the commutator body and the cup is taped, sealing it to prevent the entrance of molten solder. The entire rotor is suspended in a vertical position, with the commutator down, on an electric hoist directly over the solder pot. The commutator end with sleeve assembled is completely submerged in molten solder, covering the slots and lead ends. The rotor is left in this position until the leads are thoroughly sweat into the slots, then it is hoisted. The sleeve is easily removed with asbestos gloves, and the rotor is placed on a table to cool.

LETTERS AND COMMENTS

On Hiring New Men

BEING A NEW SUBSCRIBER, I would like to start off with an answer to a letter under the heading of Letters and Comments, just as a matter of constructive criticism. The article referred to is the one printed in the February issue and written by Sam Williams of Wingdale, N. Y. What I want to speak of in particular is his statement in regard to the kind of men employed. He says that organized labor forces employers to hire "dimwits." I take exception to that; there is not a union contract in existence today that advocates any such thing.

Mr. Williams may have meant well but he places the responsibility on the wrong man's shoulders. It seems to me that a man who is an employment manager should know first of all, the principle functions of the employes he hires. Then, when a prospective employe calls on him for employment he will know what sort of questions to ask. This will immediately enable him to decide whether the man is qualified or not and he can refuse employment if he thinks the man is not qualified. No company is compelled to hire or retain any employe who fails to perform the duties for which he has been hired and for which he has claimed qualification. In the case under consideration the fault was unquestionably that of the person who hired the man or men referred to.

If I hire a boiler fireman I need only to take the prospective fireman to the boiler room and watch his movement and observe the actions and comments he makes to know whether or not he is or has been a boiler fireman. Then, I can ask about three important questions which, if answered correctly, will enable me to decide whether or not to give him the usual try. In following this course I will not miss once in a hundred times. Once a man is hired, care must be taken to see that proper instruction is given to the new man. If this is not done, even a capable man will sometimes be confused.

St. Louis, Mo. W. R. GREEN

Takes Issue with Robert Baker

REFERRING to the letter by Robert Baker on page 102 of the February issue, I was astonished to see and read such an article, written by a competent, professional man. It does not seem to me that the publication of such criticism serves any useful purpose. Writing it, certainly, does not make a man better, on the contrary, it belittles him. I suggest that the writer of that article expends his time on something more useful to POWER PLANT ENGINEERING readers.

In my opinion Mr. Baker could have accomplished much more with perseverance and proper guidance. His critical attitude only aggravates the situation to the detriment of both employes and employer.

In regard to his statement that the man had a first class engineer's ticket, etc. I should like to express the opinion that such licenses are issued not on refrigeration experience only. It is quite possible that the man in question did not have sufficient refrigerating experience but this does not give Mr. Baker grounds for attacking his entire professional

knowledge nor the right to question the validity of the man's license. The writer holds several unlimited certificates (all on their own merits) but because I am not familiar with the details of running a mercury cycle power plant or not in accord with the economic reasons for such plants, that does not give others the right to attack me.

Personally, I have had a similar experience but in reverse. This was in a refrigerating plant of some 6000 tons capacity, with both double acting steam and motor driven ammonia compressors. My superior held a Gold Seal license and an unlimited ship ticket. He knew boilers, generators, turbines, transformers and auxiliaries, forwards and backwards, indeed I have rarely met a better all around man and his general character also was outstanding but he detested NH_3 and stayed away from ammonia repairs. This, however, did not give us the privilege of attacking his professional ability.

Highland Park, Mich. CARL BACHMANN

But It Did Work

I NOTE THAT Mr. Grant questions the home-made water level control I described in December POWER PLANT ENGINEERING.

This is just one of the many cases where the wise boys said it couldn't be done, and the wise fellows were confounded, because it could. I can tell you of several other home-made devices that are the "Daddys" of many automatic things we see today, which makes engineering seem like a midsummer's night dream to the old timers.

As to the friction, etc., this was overcome by proper packing which, we all know, can be done with a minimum of friction and no steam loss either. If this cannot be done, God help the modern boys of today.

In my 50 yr of engineering whereever I found a valve stem packed so that it stuck or leaked, I would fire the guilty man on the spot. The case mentioned was one where the engineer was also the fireman and did not have the modern devices Mr. Grant refers to as being on the market. I wonder what some of our boys would do if there were no market and no such things?

The boiler was a HRT working under 125 lb pressure. I think it was Shakespeare who said, "There are stranger things in heaven and earth, than are dreamt of in your philosophy."

Apropos home-made devices to increase efficiency, etc., in power plants I would like to contribute the following.

Back in 1910 I was engineer of a 50-ton ice plant in South Carolina. This plant was located in the basement of a wholesale grocery, and the 300 lb blocks of ice were hoisted 20 ft up to the loading platform by a chain block at the expense of much labor and cuss words.

To eliminate this, I rigged up a steam elevator consisting of a 25 ft piece of 6-in. drawn tubing fitted with a piston and connected to platform by suitable rods and guides. When steam was admitted to the cylinder under the piston the elevator would rise. Two globe valves were used in the operation, one man below loading two blocks at a time, another on platform pulling them off. We loaded 15 and 20 tons in a car with this "gadget", in less than an hour.

This is submitted as an illustration of what can be done when the market or the boss can't, or won't, furnish the ready made article. The operator opens one steam valve to lift, shut it off, and then opens another valve to let down. Very simple, and believe it or not, it worked.

Wilkes-Barre, Pa. THOMAS M. STREET

Maybe He Knew Something About NH_3

REFERRING to the operator who was afraid of NH_3 mentioned in the letter on page 102 of the February issue, I doubt very much if the man the writer speaks about was as dumb as he let on to be. The chances are, he realized what kind of a place he got into and knew that he would not stay, and was having some fun at the expense of the writer. I don't blame the wise guy for wanting to get out if there was NH_3 in the drums as the writer put it. If Mr. Baker will look at the tags on the end of his so-called drums he will find that the manufacturers of ammonia call them "cylinders" and not drums. Most refrigerants are shipped in cylinders. Carrene and trieline are shipped in steel barrels or drums.

G. S. C.

Engineer Must Prove His Worth

MR. KNAPP'S ARTICLE in the March issue of the POWER PLANT ENGINEERING, I must admit, is all too true.

Being a stationary engineer myself, holding a fair position, past president of one of the largest local engineers' educational associations in the county, also past president of a small but very exclusive association of the same type, I feel that through this contact with engineers I have a fairly good idea of their shortcomings.

It is an honest desire to further his education. Examine most of the professions mentioned by Mr. Knapp and you will find them continuously studying the newer phases of their line as well as reviewing and refreshing their memories on their past work. Show me an engineer that follows this idea and I'll show you a man that has no fear of his superior, or of being put out of a position by a public utility that tells the superintendent (that doesn't understand the first thing about a power plant) that they can supply power more cheaply.

No man, regardless of his profession, that has the personal desire to better his education, has any more opportunities to do so than the stationary engineer. In my opinion it is not the union or the educational association that is at fault—they are no better than their membership. None of these, regardless of quality or size of membership, will ever put the engineering profession up to its proper place in the professional world. The engineer himself must have that personal desire to expand his knowledge at all times through life so he can better sell his absolutely essential, services to his employer by showing where his power plant is always on the black side of the ledger. He must always have an answer to every question put to him as well as an "ace in the hole" at all times. The doctor, lawyer, the professor, yes, even the undertaker, must be on his toes at all times, not waiting for five o'clock or pay day.

If that day ever comes that the majority of engineers get a real, red blooded desire to better themselves, I feel the power engineering profession will automatically attain its proper place in the world. He will better understand the value of his service and will be truly able to present a forceful argument on wages and working conditions for himself and his assistants.

Then, in turn, the educational associations will exceed far beyond our highest expectations.

IVAN E. GOLDEN

Men of Mechanical Might

HERMAN A. KNAPP'S CRITICISM or lament has, no doubt, brought tears of self-pity to the eyes of engineers ("Men of Mechanical Might") all over the country. But what has he done to dry those tears? Really, not a thing. He brings to my mind the early days of socialism, Eugene V. Debs and "The Appeal to Reason." Questions as to policy were always welcomed but the answer to all queries was, invariably—"Oh, that will all be taken care of when we take over."

Having been one of the underprivileged and downtrodden for 35 yr, I feel entitled, in view of the many raises I have been offered and have rejected, to begin where Mr. Knapp leaves off. There is only one way to bring the engineer's true worth to the employer and that is—to leave him in the soup. Previous to this drastic proceeding, however, it is of vital importance to prepare a soup which will provide the employer with the ultimate in assorted miseries. A very good recipe contains the following ingredients.

To an ample stock of ability add faithfulness—unwavering and unfaltering determination to further employer's interests—ingenuity—indispensability—technical adequacy—instant command of any situation which may arise—availability 100 per cent of the time—willingness to subordinate personal interests—and, as that final touch, that "je ne sait quoi," an humble and thankful acceptance of any pittance the employer may see fit to pay.

This is, admittedly, a well conceived and prepared potage. Having prepared it with careful attention to all details, pick up your tools, gather up the impedimenta which has been accumulating for years, knock on the Inner

Sanctum door with unaccustomed confidence (you don't want anything, *now* but your last check) and announce with a self-assurance never before demonstrated—"Boss, I'm through."

It will, of course, be better for the Man of Mechanical Might to have previously assured himself of another position, better paid if possible.

I have personally prepared such a soup, or a possible imitation, several times in the thirty-five years since I first clanged a scoop and first spun a throttle. None of my bosses liked it after my departure. When I was there to keep it hot for them, they never knew they had it. After my departure, and when another M. of M.M., but not so much M., let it gradually chill into a sticky soggy mess, it would invariably dawn upon the Front Office that—"of all sad words of tongue or pen"—etc.

This, now, is the psychological moment. Now is when you will be offered your raise. Anything in reason if you'll only come back.

How do I know? Because I never left a position for any reason whatsoever without being eventually approached by the "Greeks, bearing gifts." But I never went back.

Peterborough, Vt. ARTHUR H. PARKER

It Might Have Been Worse

THIS ACCOUNT of an accident to a boiler may be of interest to other readers of POWER PLANT ENGINEERING.

At 2:15 on March 19, we were rounding up the shift. Number 1 boiler was out of service and the men had just come out from giving her a good cleaning out. As we stood there talking, there was a muffled explosion at the front header of No. 2 boiler. This was followed by two more. Steam and hot water poured out around the door jambs. The packing between the header sections blew out and caused the furnace to go high pressure, causing smoke and coal gas to fill the room. The pressure from this furnace carried over to No. 3 and smoke and gas billowed from it too. For a minute or two you could not see or breathe as this boiler room was built for black-out and has no windows. We managed to make our way to the door near No. 1, and opened it. The pressure on No. 2 was dying down, so we made our way back across to the other side and opened the door on that side, near No. 3. After the steam and smoke cleared away, we began to pull fire on No. 2. By this time the pressure had completely died down on No. 2 and pressure was falling down on the main line. We set two men to building a fire in No. 1 while we worked on No. 2. After everything was under control again, we examined the front header of No. 2. Four of the cast iron sectional headers had failed near the center of the boiler, about four tubes from the bottom. The moral of this story is to keep the front doors closed and securely locked. If this had not been the case the results might have been a lot worse as a coal passer was working on No. 2 at a level with the place of rupture and would have been scalded or possibly killed. Keep all doors securely closed and locked. Keep all locks and hinges in good repair at all times. If a door is supposed to have four locks, put four on it. Don't trust to three. This method, while it may never be needed again in this case more than paid for itself. The cause of this accident at the present time is unknown and may never be known, but it can happen in any plant as it did to us. It pays to be prepared. I feel that accidents of this or any other nature should receive attention of others so as to remind us that while we may have run for a good many years without one, we are not exempt. Be prepared so as to make them as light as possible when they do occur.

CHAS. W. PARKS

Improving the Operating Engineer's Status

I READ with tremendous interest, Mr. Knapp's article, "Men of Mechanical Might." The situation he presented is certainly a frank exposure of existing conditions in most places.

To cite a personal case, when I just decided to go into power plant work, I decided to try some public utility. Before taking the final step I talked with the power superintendent of a large eastern utility. He suggested that I remain with commercial concerns for the following reason. The utility will usually recruit its labor locally. The labor is unorganized and unskilled so a low wage scale exists. This scale remains very much the same until the upper brackets are reached. A large commercial concern, on the other hand, usually uses organized labor that has set up high wage scales that apply to the entire plant. This means that the commercial power plant will pay much better than the utility. Thus it seems that power plant employees are well paid only in cases where they are part of a unionized plant with a union scale or where the management has a wage scale even higher than that of the labor union.

This makes it hard for the utility to retain its trained personnel. I know of one such case where a commercial power plant is paying its firemen $1.30 per hr. A few miles further on, there is a utility that is paying its firemen about $0.95 per hr. Consequently there is a constant migration from the utility to the commercial power house.

The only solution I can visualize is an organization that might be called "The American Association of Power Engineers." An organization of this type, to be effective, would set up high standards as to education, workmanship, engineering and a wage scale suitable to each section of the country.

All power plant employees throughout the country would be affiliated members of the parent organization. It would be necessary for any power plant employer to hire his men through the main organization.

It is only in this manner that sufficient pressure can be applied to bring up the standards of the general power engineer.

The organization could set up its own boiler standards, building standards, etc., and thus tend to bring about a general improvement in power plants throughout the country. To me, power engineering is not just a division of mechanical engineering, but a field separate unto itself, and as such it ought to be taught in colleges and universities.

True, the suggestions made above are only utopian dreams whose realization in the near future is very remote but if all of us start thinking along these lines long enough, and hard enough, something good is bound to emerge.

PVT. DENARD L. GUSLER
U. S. M. C. R.

More About $1500 Men

I HAVE READ with interest your article, Million Dollar Plants vs $1500 men, also the comments from other readers on the subject.

We must all admit that the executives of our large utilities and industrial plants are highly intelligent men, but it appears that they are making a sad mistake when they invest huge sums in equipment and expect to get men to operate and maintain them at the shameful figure that many practical engineers are receiving for salary. Men who know what to do in an emergency and who possess countless secrets of the trade not found in any text books should not be expected to work for such mere pittances.

Herman A. Knapp's article, Men of Mechanical Might, should be read by many executives, and I am sure it would supply them with food for thought. If they expect men to study and prepare themselves for supervising and maintaining their plants in an efficient manner they must set a wage scale that is attractive enough to give the younger men some incentive to do more than just punch a time clock and be content to let someone else take the responsibility and the headaches for a few more dollars a week and put in hours overtime free gratis. Most chief engineers and their assistants are on straight salary and subject to call at any time, and they get plenty of calls. Some of these are pretty simple ones because the operators haven't bothered to think ahead so as to know what to do when some piece of equipment fails to function.

Are these men to be blamed? Not altogether. Give them something to shoot for and see the difference. If they know that they will be paid what they are really worth to their employers they will try to prepare themselves for vacancies which arise from time to time ahead of them. Of course, this won't apply to floaters, nothing appeals to them for more than a fortnight, but to the men who are there because they like the type of work, it would.

Waterbury, Vt. HAROLD WHALLEY

How Would You Do It?

PROBLEM 33. REGULATING SULPHURIC ACID FEED

Boy, Oh Boy. What a mess Our Hero got us into this time. For over a week, now, we have been trying to dig ourselves out from under the avalanche of diagrams, sketches, water colors and oil paintings that descended upon us as a result of Our Hero's wierd notions regarding feedwater treatment. One wonders where he runs into these diabolical ideas. Our Board of Judges, long since lost whatever semblance of sanity it possessed and most of the members are, now, safely lodged in the psychopathic ward. A few of them are still at large, however, and when last seen they had broken into a pickle factory and were feeding sulphuric acid into the pickling vats. In the meantime we were fortunate in being able to recover all the solutions to Problem 33 and have been trying to decide which to award prizes to.

It seems that almost everybody and his brother had ideas as to how to solve the acid feed problem but nobody seemed content to keep these ideas to themselves. They all sat down and wrote them out, some neatly and carefully on typewriters, others merely scribbled them on the backs of log sheets and trusted to our familiarity with Sanskrit in deciphering the material. One and all, however, they put them in the mail and sent them to us, never thinking that we might be short of help around here.

We managed, however, in fact, we did better than that, we persevered. We stuck at it, and while the rest of the nation was enjoying the Easter parade, we, poor dumb editors, sat around shuffling diagrams from one side of the desk to the other. It is lucky for Our Hero that he did not take it upon himself to come upon the premises at the time—we would have made short work of the dope.

Seriously, however, the problem had its interesting points and while it could be solved quite simply, a great many clever and ingenious solutions were submitted. Most of the solutions fell into definite classifications. Fundamentally, the simplest solution consisted in the installation of a small chemical feed pump on the main boiler feed pump and arranged so that the chemical pump would operate by the action of the feed pump itself.

With respect to this method of solving the problem, there was little question that Mr. Carter's solution, which was awarded a duplicate third prize, was the most concise and direct. He not only suggests this type of pump but gives an idea in regard to the cost and furthermore comments intelligently in regard to the use of sulphuric acid with steel tanks.

The first prize, however, was awarded to Jesse Erisman because, in addition to suggesting the use of the chemical pump he also describes several other methods of introducing the acid and presents a diagram of a simple but effective gravity type feeder which can be made by any mechanically minded man. It was because Mr. Erisman discussed the solution of the problem from all angles that his solution received recognition over some of the others.

C. G. Clark of Saint John, N. B., was awarded the second prize because, like Mr. Erisman, he analyzed the problem from all angles and in addition to the use of a positive displacement type of pump he suggested the use of several other methods.

Peter N. Choporis of Detroit tied with Mr. Carter for third prize and received a duplicate third prize award. Mr. Choporis also suggests the use of the positive displacement type of pump but in his case we were influenced in our decision by the excellent perspective drawing which he submitted. This drawing, shown in Fig. 3, was submitted exactly as reproduced. He also introduces the acid directly into the feedwater pump suction line.

It will be impossible to refer in detail to the many ingenious solutions to the problem in the space that we have allotted to us here so those that are not commented upon here will be discussed in the June issue. We feel that too many of the readers spent too much time and effort in working up the solutions to have their efforts go for nothing.

In any discussion of a problem of this kind, we always realize that there is commercial equipment on the market that can effectively meet the requirements of the problem but at the same time know that practical engineers often have to devise their own arrangements. In many cases, small plants are not able to secure high enough priorities to buy such equipment and so the engineers are compelled to improvise.

The prize winning solutions follow:

FIRST PRIZE AWARD

Jesse Erisman
St. Louis, Mo.

As usual in Our Hero's problem, there are several solutions of which he can take his choice. However, as a warning to him, I advise him not to be too cheap in the selection of his acid feeding equipment, since the price of corroded storage tanks, pipe lines, pumps, and boilers come high. Also, as he has already found out, crude methods result in more labor.

I believe the simplest method is to place a small, lever-operated, stainless steel, needle valve in the acid feed line and connect it by suitable linkage to the lever of the storage tank float valve, in such a manner, that the acid and water valves open and close together. Since the relationship will be more or less fixed, the proportioning can be varied by changing the dilution of the H_2SO_4.

From the illustration, it appears that Our Hero's pump is of the duplex reciprocating type. This allows the use of another method of automatic proportioning, which is better than the first method. This consists of a small proportioning pump, reciprocating type, operated by various levers attached to the valve arm of the boiler feed pump. The acid pumped will then vary directly as the water pumped. For control, a small by-pass valve can be installed around the acid pump, or the strength of the acid can be varied as in the first method. On some of these proportioning pumps, the capacity can be varied by changing the length of the stroke. The discharge of the acid pump should be into the storage tank, near the outlet of the make-up water line, in order to effect a better mixture.

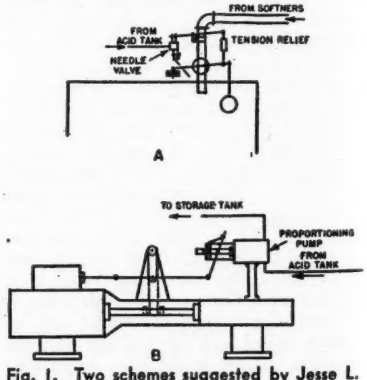


Fig. 1. Two schemes suggested by Jesse L. Erisman

Better mixture could be obtained if the water make-up outlet was piped to the edge of the storage tank, farthest from the pump inlet and using a 45 deg ell, the water could be made to hit the surface at an angle, thereby creating a swirl in the storage tank.

Equipment can also be purchased that will vary the amount of acid added to correspond to the varying pressure differential that would be created across an orifice plate, by the changing flow of the make-up water.

The above named methods are only automatic in the proportioning sense. One leading manufacturer of control equipment can supply apparatus that will vary the amount of acid feed to correspond to the pH of the water.

Regardless of how automatic the control equipment is, check analysis should be made as often as practical.

The effect of the changing acid head can be made negligible by one, or a combination of, the following:

1. Use acid tank of larger diameter and smaller depth.
2. Use larger piping, up to the needle valve or acid pump intake.
3. Fill acid tank ½ full twice a day instead of full once a day.
4. By placing the acid tank higher above the storage tank. The higher the acid tank the greater the ratio between total head and the varying tank head. For example, with bottom of acid tank 1 ft above storage tank, and acid tank level 1 ft when full, then when acid tank level is just reaching bottom, the total head has been reduced ½, but if bottom of tank is 5 ft above, then when tank level falls to bottom, the total head will have only been reduced 1/6.

In all of the above methods, material resistant to acid corrosion or attack is understood to be used where the acid solution comes in direct contact with it.

Problem 34
The Case of The Dirty Lanterns

Our Hero runs into the queerest things. This month, for some strange reason known only to himself, he took a trip up to Peterborough, N. H., and as might be expected, ran into our old friend, Arthur Parker, the genial and capable chief engineer of the Peterborough Hospital. Brother Parker, as usual was up to his neck in a multitude of problems involving everything from the control of oxygen tents to the maintenance of fire extinguishers. Our Hero, always a bear for punishment, in a vicarious sort of a way, immediately became interested in all of them and spent much of his time investigating conditions around the hospital. After narrowly escaping detention in the psychopathic ward — for some reason the doctors there seemed to find him interesting—he wandered down into the hospital root cellar, where he found a number of dirty lanterns burning. "Why don't you clean these lanterns?" he asked Mr. Parker. "You can't see anything this way."

"Well, you see, it's this way," said Parker, "these dirty lanterns seem to give out more heat than clean ones and since it is only by the use of these lamps that I can keep this cellar from freezing up, I keep them dirty. If a potato gets cold feet at temperatures much below 40 F it's just too bad."

If this is true, why? Why should a dirty lantern throw out more Btus than one with a clean globe? Our Hero does not know, so, as usual, he comes to us.

That is our problem, this month. Write out your opinion of this in a letter of not more than 1000 words and send it to us. Use whatever knowledge of physics you have in explaining it. We will award a $25.00 war bond for the best letter, and prizes of $10.00 and $5.00 respectively for the second and third best letters.

Entries for this contest should be mailed not later than May 31, and should be marked, Problem 34. Address all letters to the Contest Editor, Technical Publishing Co., 53 West Jackson Blvd., Chicago 4, Illinois.

SECOND PRIZE AWARD

C. G. Clark
Saint John, N. B.

There are great many possible solutions to the problem of feeding sulphuric acid. In general they may be classified as follows:

CHEMICAL CONTROL

The acid feed could be regulated by an automatic valve actuated by a controller to maintain the desired alkalinity in the water leaving the mixing tank. This method requires a pH or similar meter with a pneumatic, hydraulic or electric control system to operate a valve in the acid line. It is independent of variations in acid tank level or of water flow rate. It would

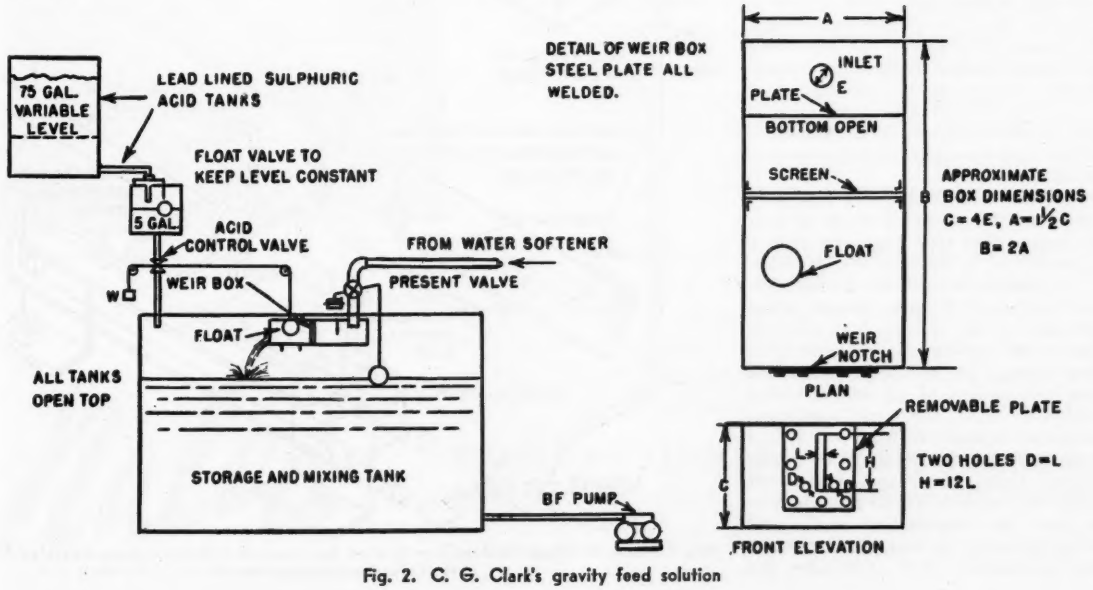


Fig. 2. C. G. Clark's gravity feed solution

probably give the most accurate control of all systems.

Positive Displacement Feeders

Many types of proportioning equipment are available which operate from mechanical flow meters of the rotating element type and give a positive feed of the controlled fluid by the operation of a piston, diaphragm, or squeezing action on a flexible tube. The feed is directly proportional to the water flow regardless of variations in flow rate, water pressure or acid tank level. The acid addition, of course, bears no relation to variations in alkalinity.

Feeders of this type can also be operated from the piston rods or valve rods of the boiler feed pump if of the reciprocating type. This would not be as accurate as a metering proportioner since the water displacement per stroke may vary with feed pump speed somewhat.

Feeders may also be obtained from several manufacturers which are operated through impulses from orifice or venturi tube flow meters. If there are existing meters on the feedwater line attachments may be made at a small cost.

Gravity Type Feeders

For all types of gravity feeders the first essential is to provide a constant head on the orifice or control valve used to vary acid flow rate. This can be accomplished by raising the acid tank so that the variation in head due to emptying is small compared with the total head. Another method would be to alter the tank shape so that the variation in vertical dimension is made so small as to minimize the effect of tank emptying on flow rate. Probably the best method is to install a second head tank of small size in which the acid level is held constant by a float valve as indicated in the accompanying sketch.

With the acid level held constant the acid flow rate can be controlled in a variety of ways as follows:

1. By direct lever connection from the present float valve. The acid valve has to have a flow vs stem lift characteristic similar to the present float valve to give correct proportioning of acid to feedwater unless the motion is transmitted through a correcting cam drive.

2. Both float valve and acid feed valve can be operated from a float through a pilot type controller with a pneumatic or hydraulic power cylinder.

3. Both methods 1 and 2 above depend for accuracy on a constant water pressure on the present float valve so that equal openings always give equal flow rates. To make the acid feed rate independent of all values except feedwater flow the acid regulating valve can be operated from a float in a weir box located in or above the water storage tank. The shape of the weir notch can be made to suit the acid flow vs stem lift characteristic of the acid valve available so that direct connection is possible. The acid valve can be pilot operated but direct action is simpler and with this size valve should give satisfactory results. If an acid valve can be obtained with a straight line flow characteristic a weir notch of the type illustrated can be used. This type of weir notch is easily cut and closely approximates the true straight line weir notch which has to have curved sides following the equation $l\sqrt{h} =$ a constant where l and h are the notch width and height respectively. The flow is given by the formula $Q = 7.55\ (l\sqrt{h})h$ in which Q is in cfs and h and l in feet. The constant in this formula is determined from the maximum flow rate by assuming "h" and solving for "l." The exact area for the weir notch can be calculated if the water flow rate is known. If not it can be obtained by cut and trial by making the notch in a separate plate and bolting it to the weir tank. Having the weir tank over the storage tank will prevent any damage through overflows.

This method is suggested as being the cheapest and best for the conditions stated in the problem. Details are indicated by the accompanying sketch. The variation in alkalinity of the softened water is not stated but apparently acid flow in direct proportion to water flow is known to be satisfactory. No statement is made of water flow rate but as a guide to weir notch size a notch 6 in. high by ½ in. wide with two ½ diam holes will pass a maximum of about 12,000 lb per hr. Weir notch selection should be such as to give a variation of at least 4 in. in head to operate the acid control valve.

For the acid control a lever or cam operated clamp can be made for use on a rubber hose if variations are not too rapid or extreme. A clamp type valve may simplify the equipment maintenance. This type could also be used if desired on the float control of the additional acid head tank.

THIRD PRIZE AWARD

Peter N. Choporis
Detroit, Mich.

From the diagram we note that Our Hero is using a reciprocating

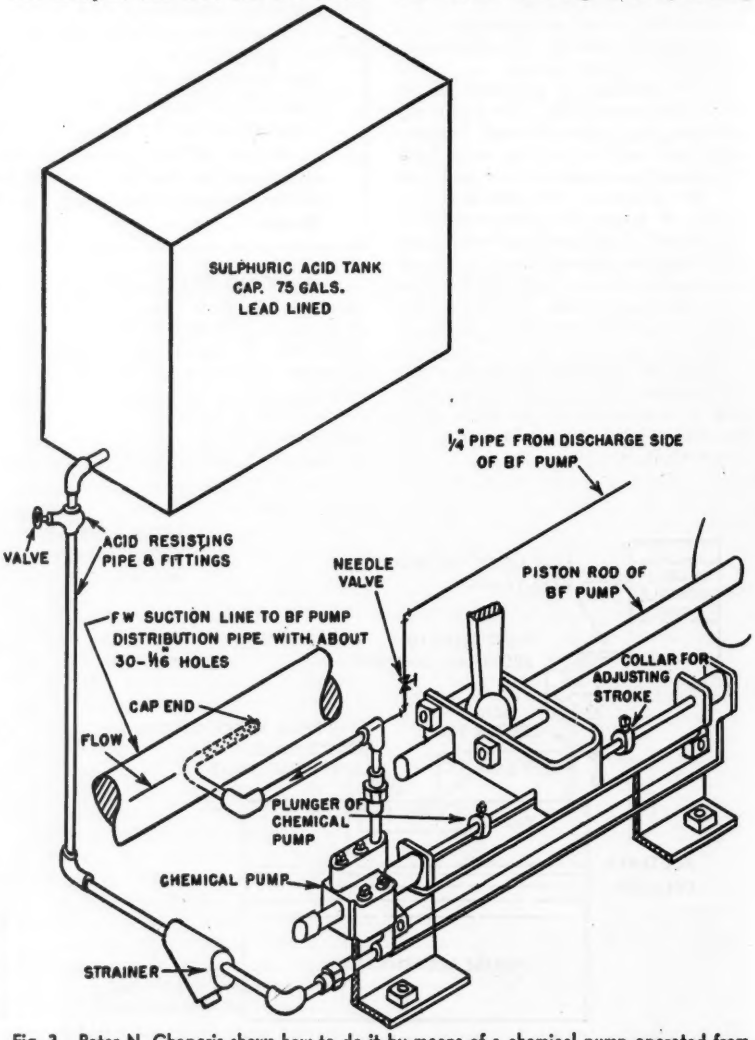


Fig. 3. Peter N. Choporis shows how to do it by means of a chemical pump operated from the boiler feed pump piston

HOW THE MAILMAN...

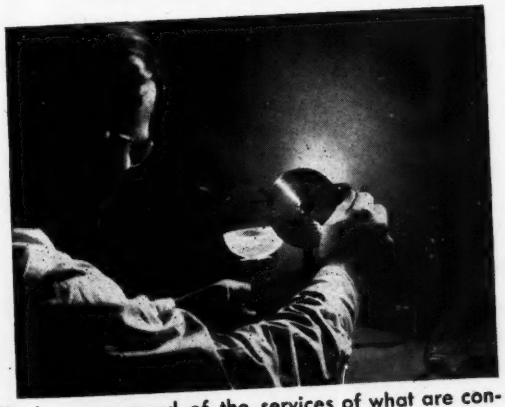
NALCO SYSTEM SERVICE REPORT CARD

FIRM _____
ADDRESS Cleveland Ohio.

DATE	H	P	M	Na Cl	Na_2SO_4	DS	PO_4	LBS. NALCO		GALLONS OF WATER TREATED
3-6	0.0	15.2	21.6	23.0	25.5	79.5		21		25,600
3-7	0.0	16.1	22.0	25.0				18		21,350
3-8	0.0	21.6	28.0	28.5	32.5	98.0		24		27,480
3-9	0.0	22.4	30.6	27.0				24		22,800
3-10	0.0	17.3	23.1	25.5	28.0	89.0		21		24,600
3-11	0.0	14.8	19.3	24.8				24		26,500

Raw Water H 7.8, G. P. 5.4, M. 5.2, CO_2 Na Cl. 1.9 Clear or Muddy? clear
Quality of Steam Dry Condition of Boilers good Coagulation good
Blowdown Interval Continuous - plus - one hand blow per 24 hrs
Remarks:
Signed John Smith.
Form 76-I 10M 11-43 w

HELPS SAVE COAL...



You have command of the services of what are considered to be the world's finest water treatment laboratories when you use Nalco Water Treatment Service.

According to one authority, 1/10" scale on a boiler tube will cause heat losses as high as 16%, with consequent serious waste of critical coal. If your water treatment is correct, you won't have any scale. *But how do you know it is correct?* Conditions change.

Supplementing the Nalco personal field service system, you *mail* reports to the Nalco Laboratories, from which they can tell if there is any change within your boiler which might cause operating difficulties. They tell you or show you what to do about it *before the damage is done.*

It's simple, easy and takes but a few minutes, and then you *know* how to control your water treatment, blow-down and other factors to prevent scale and carryover, save coal, and maintain peak boiler efficiency. To eliminate guesswork, write to Nalco today for a survey of your plant.

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boiler feed pump and with this type of pump he can very simply and economically solve his problem by using a rocker-arm pump.

The frame of the rocker-arm pump is bolted to the frame of the reciprocating boiler feed pump, and the extension rod is fastened to the actuating rod of the boiler feed pump.

This type of pump solves the problem of proportioning a given quantity of treating chemical to a certain quantity of feedwater, pumped in the simplest manner—a stroke of the chemical pump for each stroke of the boiler feed pump. This assures correct proportioning with the widest variation of flow.

The stroke may be adjusted to suit the amount of chemical required by setting the collars on the plunger to regulate the stroke. A capacity of from 0 to 20 gal per hr may be obtained, depending upon the length of the stroke, pump speed, size, and manufacture of pump.

Also it is suggested that Our Hero dilute his acid in the tank to a 10 per cent solution. This, together with a ¼-in. water line from the discharge side of the boiler feed pump, to the side of the chemical feed pipe to the suction, will assure complete dilution of the acid before it enters the water stream in the boiler feed pump suction. Figure 3 shows the method of installing the pump and the connecting piping.

DUPLICATE THIRD PRIZE AWARD

R. E. Carter
The Niles Rolling Mill Co.
Niles, Ohio

The simplest and most accurate method of introducing sulphuric acid or other chemicals to boiler feedwater in small quantities is to use a device very similar to a lever operated or force feed lubricator, installed on the boiler feed pump and operated by the reciprocating arm of the pump so that with each stroke a small amount of chemical is injected into the water.

A mixing tank is not necessary, as the lubricator type pumps develop a very high pressure and chemicals may be injected directly into boiler feed line. This positive feed also overcomes any variable in chemical tank pressure.

On installation of such as above, the amount of chemicals desired are adjusted by sight feed and/or ratchet lever.

When the correct proportions are attained, nothing remains except to keep the chemical tank filled in that each pump (water and chemical) are discharging a metered amount in synchronism.

These units are cheaper purchased than hand-made and can be bought from such as Manzel Bros. Co. for approximately $30.00 each — made expressly to handle chemicals.

It may be well to note that the undiluted H_2SO_4 may be safely stored in a steel tank and piped to chemical feeder in ordinary black pipe and fittings.

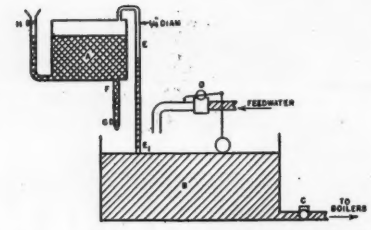

Fig. 4. An ingenious arrangement devised by Frank Gibadlo

General Comment

A. B. Summers of Louisville, Ky., also suggested the use of a positive displacement chemical pump. He suggested the use of a force feed oil lubricator type of pump, attached to the boiler feed pump by means of a lever and linkage.

As already pointed out, some of the solutions were very ingenious. Take Frank Gibadlo's for example. His scheme is shown in Fig. 4. Quoting from his letter, "The acid is introduced into the acid tank A, via the funnel and the flow controlled by opening the acid resisting valve or pinch cock H. During this time the acid resisting valve or pinch cock G, is closed. The air is displaced by passing out through E. This tube E may only be open at the end. When the water level in B is at its highest point and the valve D is entirely shut off, the outlet of E is at the water level and the air is prevented from passing into the tank A, thus preventing the flow of acid into tank B. When the level in B falls, air immediately passes up through E into A, and as long as the level is below E, the acid flows into B. The height of liquid in tube E should equal the height of the liquid from tip of nozzle G to the liquid level in A, if the fluids are similar. Actually, the level in E is higher due to the lower gravity of the feedwater — both should weigh the same, however. The vertical height of E should be considerably higher than the height from G to the level in A, otherwise the feedwater would be sucked into A. The rate of acid flow can be varied by adjusting the opening at G, by varying the diameter of tube E. A critical or loose adjustment of valve D, producing an instantaneous or a lagging flow of feedwater will result in a relatively uniform or lagging rise and fall of the liquid level, which, in turn, will influence the amount of air entering A, consequently, also the flow of acid at G."

Among the more ingenious gravity types of feed, the arrangement proposed by E. E. Wolfe of University City, Mo., has a great deal of merit and is well designed from a practical operating standpoint. Mr. Wolfe also submitted a very finished perspective drawing which is reproduced in Fig. 5. Mr. Wolfe points out that fully automatic control which will give the desired alkalinity regardless of flow rates or acid strength constitutes a problem not readily solved by home-made devices and should be left to manufacturers of control equipment. It is possible, however, to devise a simple arrangement which may meet the needs of Our Hero. "The arrangement depicted in Fig. 5 is an adaptation of a set-up used by the writer many years ago for feeding lime. No claim is made for originality.

"The feedwater is regulated by a valve floating in the feed storage tank. As more water is withdrawn from this tank, the head falls, allowing raw feedwater to raise the head on the V-notch weir. This added head raises the float-controlled lever bar.

"The acid is drawn from its storage tank by means of a small pump (centrifugal or plunger) to a small V-notch weir box where part of the acid flows over the weir to join the discharge water from the weir of the feedwater.

"The excess acid overflows into a sawed-off elbow which is fastened to a short length of rubber hose, and this

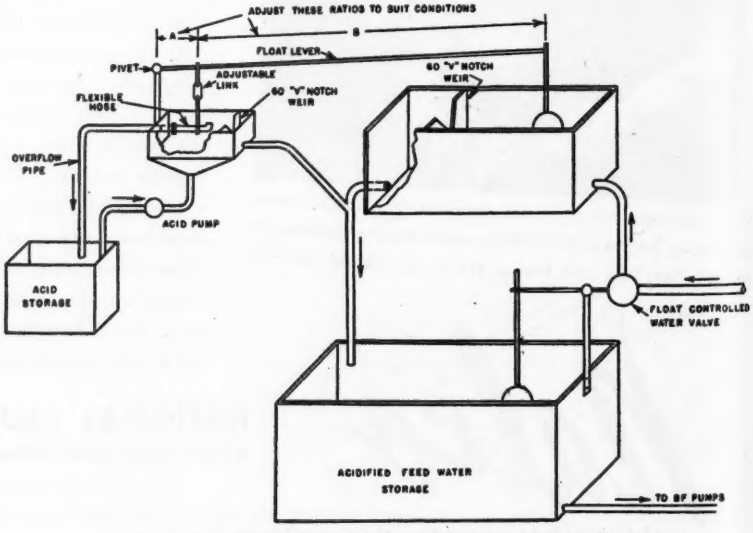

Fig. 5. E. E. Wolfe also uses wier boxes controlled by floats

LEAKY VALVES DON'T HELP PRODUCTION...

So Keep 'Em Tight

Fig. 1430
Iron Body Gate

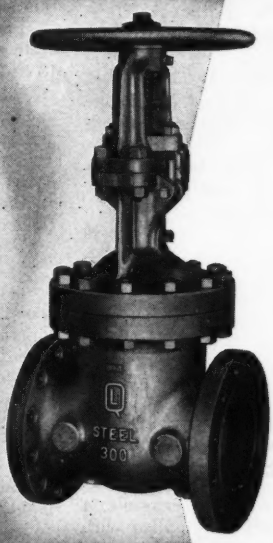

Fig. 1938
Steel Gate

The time necessary to maintain a careful check on valves . . . to see that they are kept tight and in good working order . . . is time well spent. Valves are tremendously important links in any production schedule.

Valve leakage of steam, water and air is not only costly in itself . . . it slows down production and can, if neglected, lead to serious delays and the loss of valuable time.

Lunkenheimer Valves, of whatever type, with their simplicity of design and built-in lasting qualities, are good insurance against production delays due to valve failure. They are helping many a maintenance crew do a better job easier.

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Fig. 1640
"King-clip" Gate

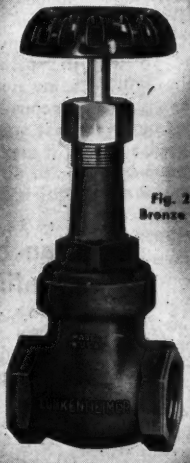


Fig. 2125
Bronze Gate

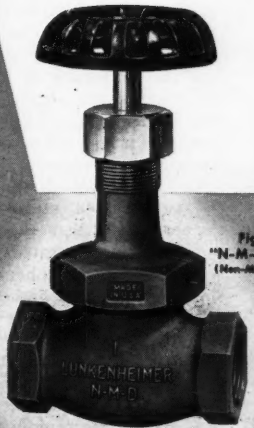


Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

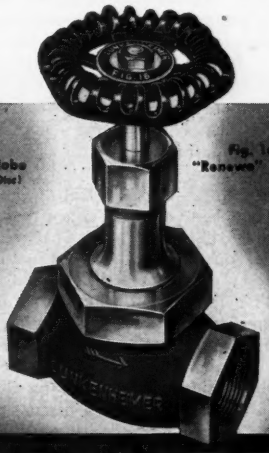


Fig. 16
"Renewo" Globe

LUNKENHEIMER VALVES

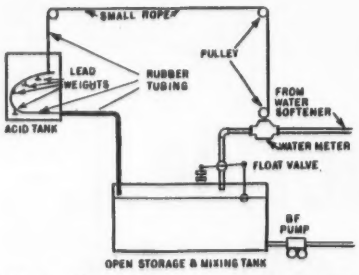


Fig. 6. This curious arrangement was proposed by E. H. Roper

hose in turn is attached to the return pipe to the acid storage tank.

"Attached to the float lever bar is an adjustable link which terminates in a hose clamp around the rubber hose.

"Any rise and fall of the float lever bar thus causes a corresponding rise and fall of the horizontal rubber hose, so that in effect the head on the acid V-notch weir changes in the same direction, and proportionately, with changes in the head on the larger V-notch weir of the feedwater.

"An adjustable link is used so that zero head on the small weir can be made to correspond to zero head on the large weir.

"The point selected on the float lever bar to which to attach the adjustable link is determined by the relative volumes of acid and feedwater, and this naturally is largely determined by the strength of acid used. By way of example, if the volume of feedwater is 20 times the volume of acid of a selected strength to give the desired alkalinity, the point to attach the adjustable link would be at 1/20 the distance from the pivot end."

Figure 6, submitted by E. H. Roper of Toledo, Ohio, shows what a fertile mind can accomplish. As Mr. Roper put it, "Our Hero should experience no trouble in making up and operating the system outlined in the sketch (Fig. 6). The meter with the pulley is a standard article but a dial meter could readily be adapted. The proportion of acid feed could be regulated by diluting the acid. The only additional attention needed is the winding on, of the cord."

More to Come

The solutions presented here constitute only a small portion of the many submitted. Space is not available to present others here, but we will present as many as possible in this section in the June issue.

Questions And Answers

Question No. 259

Does Saturated or Superheated Steam Give Higher Heat Transmission?

WHICH GIVES the higher heat transmission in a closed heater or heat exchanger, saturated steam or superheated steam? Most engineers believe that saturated steam is best in such cases. But I have seen a number of statements in recent years to the effect that, in many cases, superheated steam is best. Can you give me some information about this?

Chicago, Ill. M. B.

EDITOR'S NOTE—A great deal of research work has been done in recent years on the whole subject of heat transfer. Here is what one of the standard textbooks has to say on the point in question:

"The question of whether saturated or superheated steam gives higher heat transmission is often discussed. For a large number of cases this question may be decided by considering the remarks on pages 20-22 (a discussion of factors affecting transmittance). When there is a resistance to heat flow which is large relative to the film resistance on the steam side, superheated steam will always give a higher transmission than saturated steam. For example, a domestic steam radiator supplied with superheated steam will give off heat to a room more rapidly than if it were supplied with saturated steam *at the same pressure.* In this case the film resistance on the air side is so large that the difference in film resistances for superheated steam on the steam side is negligible, while at the same time the transmission is increased by the higher temperature of the superheated steam. With the saturated and the superheated steam at the same temperature rather than at the same pressure, the saturated steam will, of course, show the higher heat transmission, owing to its higher surface conductance. With respect to the relative heat transmission from condensing superheated or saturated steam, M. Jakob and S. Erk* found that condensing superheated steam will generally deliver heat more rapidly to a surface at a temperature below the saturation point than will saturated steam at the same pressure.

"If the other resistances to heat flow are small compared to the film resistance on the steam side, saturated steam will generally show a higher heat transmission than superheated steam which is not condensing. In any case the question may be decided definitely by determining the individual surface conductances."—Dr. Alfred Schack, "Industrial Heat Transfer," pp. 171-2, Publ. 1933. John Wiley and Sons, Inc, 440 Fourth Ave., New York City.

* M. Jakob and S. Erk, Heat Transfer in the Condensation of Superheated and Saturated Steam, *Forsch. Arb. Ingenieurwes,* 310 (1928).

Question No. 260

How Prevent Spontaneous Combustion of Coal in Silos and Bins?

WE ARE PREPARING plans for a coal silo of 24 ft inside diam for storing a reserve supply of coal. We are wondering about the possibility of spontaneous combustion of coal stored in this silo.

The silo will include a sloping concrete shelf, the lower edge of which is 18 ft above the bottom. Coal to be stored is Southern Ohio bituminous and West Virginia; sizes are ¾ in. and small nut and slack.

The reason for such a large capacity is that there is no storage space available on the ground. The plant capacity is fairly high, hence a reserve coal supply must be kept on hand.

What precautions can be taken to prevent spontaneous combustion in this silo? How effective are these precautions? What are suitable methods for extinguishing a fire if it should get started in this silo?

Toledo, Ohio E. H. R.

WE HAVE a storage bin 50 ft long by 50 ft wide by 16 ft high in which we store a reserve supply of coal. We would like to consider increasing the length of this bin to 100 ft, to store twice as much coal. The bin is underground and on a level with our boiler house floor.

But we have had experiences with the coal catching fire in our present bin after being stored for several months. So naturally we don't want to enlarge the present bin unless we can find some definite means to prevent spontaneous combustion of this coal or at least some good way to put out a fire if it starts. What is the best thing for us to do?

Prairie du Chien, Wis. W. N. S.

Question No. 261

Can He Use Induction Heating on This Job?

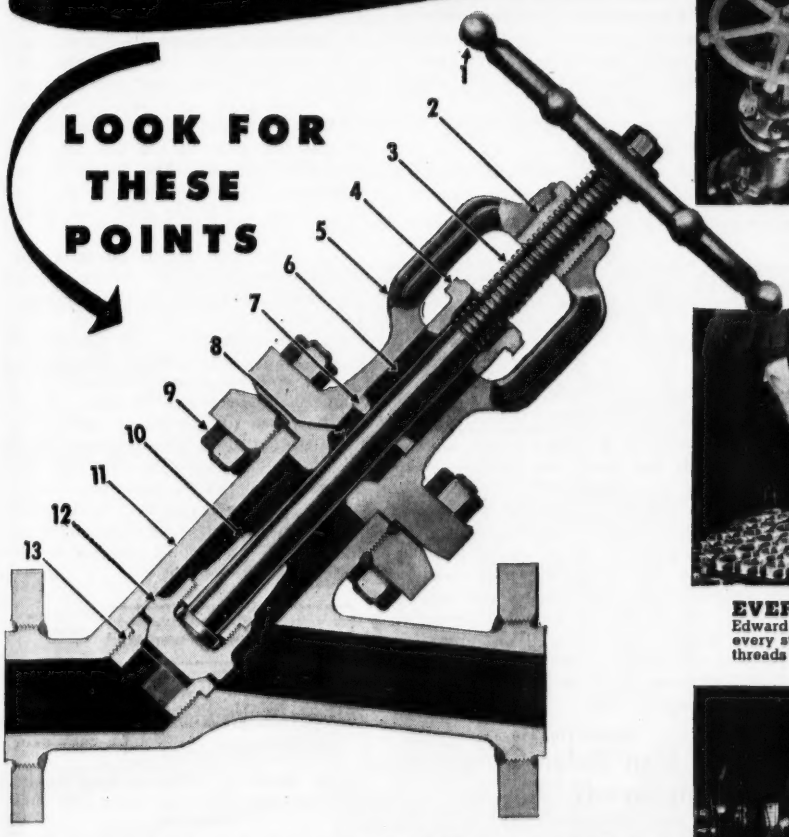
CAN I USE induction heating to heat several thousand 12-in. lengths of standard ¾-in. Schedule 40 seamless steel pipe from room temperature up to 1000 F? If so, what sort of equipment can I use to do the job? I can obtain as much as 200 kva of 3-phase, 60-cycle power at either 2300 v, 440 v, 220 v or 110 v.

This pipe has a nominal internal diam of 0.824 in. and wall thickness of 0.113 in. It is to be heated throughout, not merely on the surface or in one

NUMBER TWO OF A SERIES ON VALVE SELECTION

How to buy a *Blow-off* VALVE...

LOOK FOR THESE POINTS



1 **Handwheel.** Strong, knobbed, easy to grip even with wet hands. Oversize dimensions make operation easier.

2 **Yoke Bushing.** Bronze. Completely machined in one set-up so internal and external threads are perfectly concentric.

3 **Stem.** EValloy stainless steel with low coefficient of expansion to prevent loosening in cooling.

4 **Gland.** Forged steel, smoothly machined to prevent binding or scoring.

5 **Bonnet.** Forged steel, integral yoke post design to prevent misalignment.

6 **Packing.** Die formed temperature resisting EValpak.

7 **Junk Ring.** Accurately fitted to stuffing box.

8 **Cooling Chamber.** Large condensate chamber to protect packing.

9 **Studs and Nuts.** Through bolted joint makes disassembly simple.

10 **Disk Nut.** Heavy steel with backseating surface for repacking under pressure.

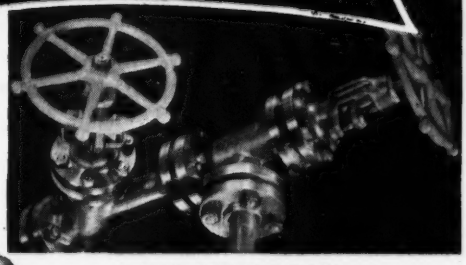
11 **Body.** Streamlined steel body with no unnecessary parts to clog or erode.

12 **Disk.** EValloy stainless steel or Stellite hard facing, precision borized with mating seat.

13 **Seat.** EValloy or integral Stellite seat, mated with disk.

Built in three pressure classes—300 lb., 600 lb. and 900-1500 lb. sp.

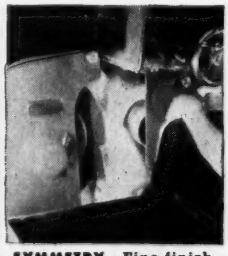
NEW! Catalog 12-D covering Edward blow-off line soon off the press. Write for your copy today.



FIT ANY SPACE. Edward steel blow-off valves are built in both straightway and angle design, offering a variety of hookups to fit installation space needs.

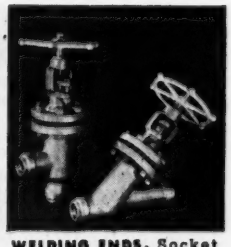
EVERY-STAGE INSPECTION. Rigid Edward inspection procedures check all parts at every stage of manufacture. Inspector above gages threads of wear resistant EValloy valve seats.

FORGED. Drop hammers forge many parts of Edward blow-off valves for top strength in hard usage.



SYMMETRY. Fine-finish, perfect symmetry of EValloy stems is achieved by centerless grinding.

BORIZED. Mating blow-off seats and disks are precision borized at exact angles in same operation.



WELDING ENDS. Socket welding ends, as well as flanged ends, are available in Edward blow-off valves.

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EDWARD *Steel* VALVES

particular section of the pipe.

How long will it take to heat up one length of pipe by induction heating? Can I heat them as they pass through some kind of a heating device on a conveyor or will it be necessary to handle each piece separately?

I understand that there are two kinds of induction heating: high frequency and low frequency. Which kind should I use?

Detroit, Mich. J. O. S.

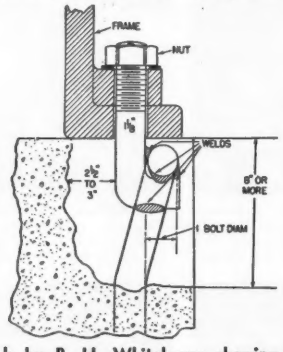
Answer No. 247

The Last of the Broken Anchor Bolt

No SOONER had we put the April issue on the press, containing the article about different ways to repair C. I. P.'s broken Diesel engine anchor bolt, than we received another good suggestion from our friend B. H. Whitehouse. Immediately after it came a letter from the original questioner showing how the bolt was actually repaired.

Repair by Bending and Hooking on an Extension

ASSUMING THE BOLT to be sound and properly anchored below the break, remove the cement below the machine frame, to allow sufficient room to work, about 3 in. back of the bolt and to a depth of about 8 in. below the frame. Cut the bolt off close up under the frame (within ½ or ¾ in.). Use an acetylene torch. Now heat the bolt at a point just above the cement and, with a bar or other tool, bend the bolt towards the outside of the frame about the diameter of the bolt. Allow it to cool. Next heat it at a point about 2 in. from the top and make a sharp bend (right angle) either to the right or left.



Sketch by B. H. Whitehouse showing how anchor bolt and extension are bent and welded

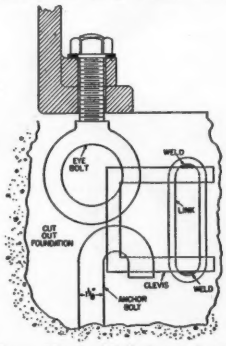
Now select a piece of rod the same size as the bolt and thread one end and bend another sharp right-angle at the other end similar to the one already formed on the anchor bolt. The length of this new piece should be such that when it is in place, the right-angle hooks or bends will just engage lightly when the nut is within one turn of being in a position where the bolt and nut are even. Now weld the two hooks or bends together; tighten the nut, repair the cement and the anchor bolt is as good as ever.

If there are doubts as to whether or not the original bolt is sound, proceed according to the description in my article "Crow Foot Anchor Bolts Stay Put" published in the May, 1942, issue of POWER PLANT ENGINEERING.

Prospect Ave. Plant
A. O. Smith Corp. B. H. WHITEHOUSE
Milwaukee, Wisc. Chief Engineer

And Here's How the Job Was Actually Done

IN SEVERAL recent issues of POWER PLANT ENGINEERING you have published considerable comment on the problem of our broken anchor bolt. We greatly appreciate this and thank the many



Sketch from H. B. Nicholson showing how ring bolt and clevis were used to repair anchor bolt

engineers whose suggestions were forwarded to us before publication.

The attached sketch shows how we repaired this bolt. We used calcium chloride with the cement and soaked the old foundation well with vinegar to make a good seal. We hope this idea will help somebody.

Chestertown Ice Plant H. B. NICHOLSON
Chestertown, Md. Manager

Answer No. 248

How Can Boiler Operation Be Improved?

IN THE February issue, J. S. R. asked (A) Should he not be getting more than 9 per cent CO_2 and less than 560 F average flue gas temperature on his two 600-hp, four-drum, bent-tube boilers, fired with Northern Illinois 1-in. by ¼-in. wash nut on forced draft chain-grate stokers? (B) Why does fire on one stoker burn V-shaped, that is, one side 4 or 5 ft shorter than the other? (C) Should he insulate the 16 drum heads of these boilers, which were left uncovered when installed?

Fire too Short, Says Pef

J. S. R. STATES that he is using wash nut 1 in. by ¼ in. on his forced-draft chain grate stokers. While I do not have the price of the available coals before me, there is no doubt that unwashed and unscreened coal such as 1 in. by 0 would be the more economical to use. The heat efficiency may decrease but the dollar efficiency will increase. Chain grate stokers are well adapted for burning unscreened coals. In making comparative estimates, the cost of removing ash should also be included, since with unscreened coal the ash content will be greater. The fuel feed should be increased 6 to 7 in.

A. The 560 F flue gas temperature is not high, provided the boilers are operated at 150 per cent load or better, which for the 600-hp boilers means about 30,000 lb per hr each. The 9 per cent CO_2 is not bad but if there is no objectionable smoke it should be increased to 10 or 11 or even 12.

B. Aside from the fact that the fire does not burn even, it is a short fire. In fact I am surprised that an average of 9 per cent CO_2 has been obtained with so much of the grate area inactive. The entire grate area should be covered with live fire. Even though some of this fire goes in the ash pit, this loss will be more than made up by reduction of the stack loss. I attribute the uneven fire to the gates not being evenly opened.

C. There can be no question but that the heads of the drums should be covered, leaving only the manholes bare.

Oak Ridge, Tenn. N. T. PEF

Coal Segregation Is to Blame, Says Stock

THE DIAGRAM as submitted by J.S.R., page 106, February, 1944 issue, showing how one side of the fire on one of his chain grate stokers burns 4 ft to 5 ft shorter than the fire on the other side, definitely indicates trouble due to coal segregation. As a result he is experiencing low CO_2 and high combustible ash. The capacity of his boiler is also reduced.

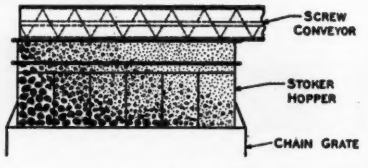


Fig. 1. Sketch by Arthur J. Stock showing how coal segregation can occur with screw conveyor

J. S. R. does not describe how he gets his coal into his stoker hopper. This is probably done by either of the two means as shown in Figs. 1 and 2. Figure 1 illustrates a screw conveyor which puts the coal into his stoker hopper from the right hand side. This screw conveyor is started periodically and when started the coal is probably 3 ft or 4 ft down in the stoker hopper. The first coal deposited in the stoker may form a pile over which the coarse coal rolls. As a result, there may be

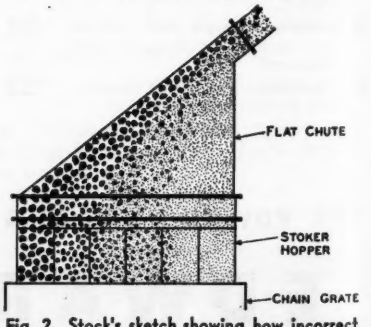


Fig. 2. Stock's sketch showing how incorrect chute can cause segregation

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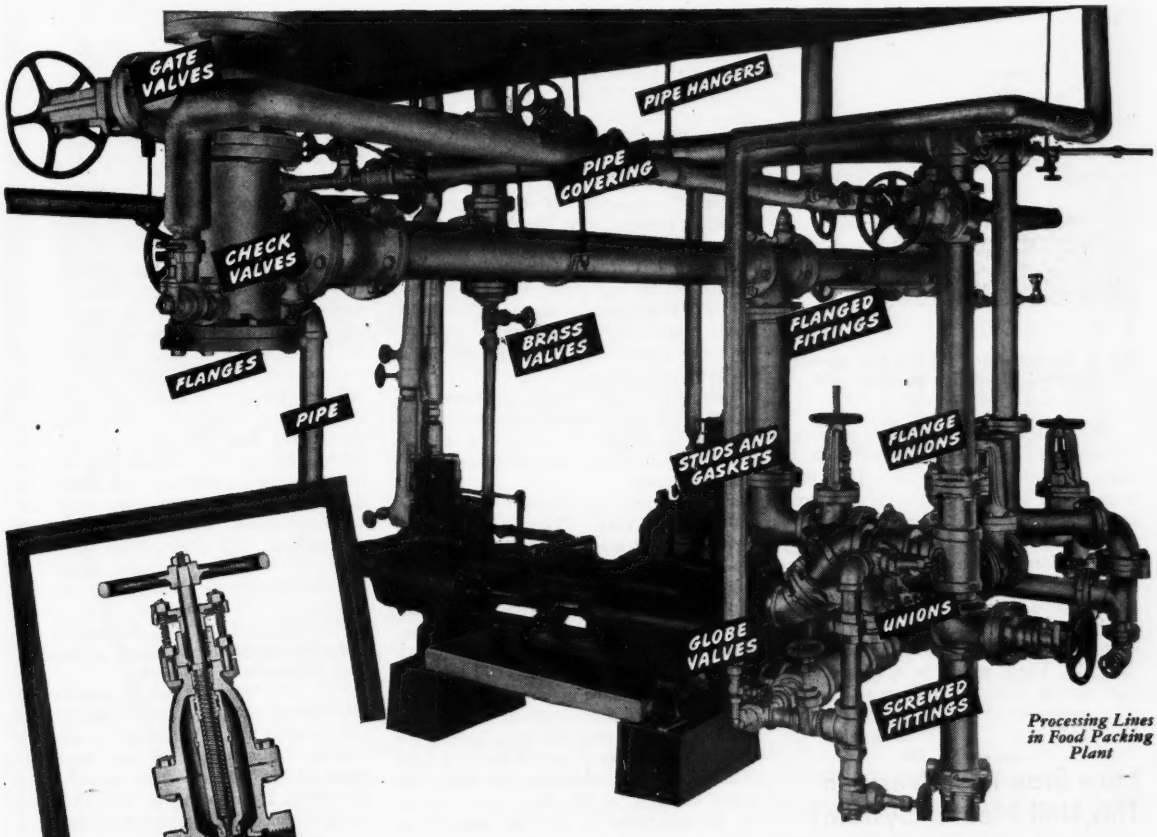
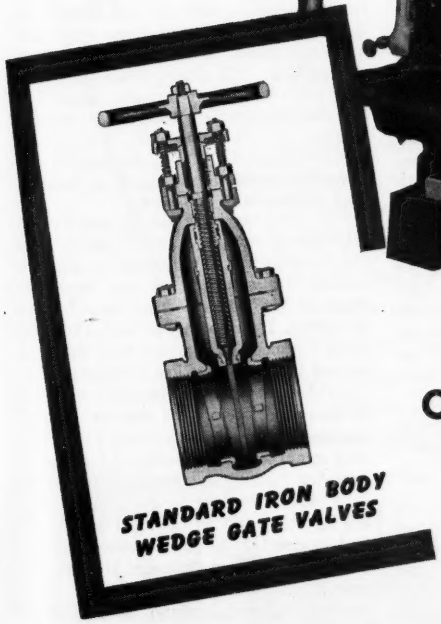
FROM single pipe fittings to complete piping systems, you stand a better chance of getting just what you need from Crane. For, at Crane you choose from the world's largest selection of brass, iron, and steel materials for every piping service.

In the installation below, for example, every item, pipe, valves, fittings, even studs, gaskets and insulation, are from Crane. Consider the advantages of this single source of supply—how it saves ordering time, simplifies maintenance and keeping of parts stocks. Consider the protection afforded by undivided responsibility for all materials—especially when that responsibility is backed by Crane Co.'s 89-year leadership in the piping field. Are you getting these benefits now? CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill.



Processing Lines in Food Packing Plant



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considerable coarse coal on the left-hand side of the stoker hopper and practically nothing but fine coal on the right-hand side.

Figure 2 illustrates another possible arrangement in which the stoker hopper is fed with a flat chute, which receives its coal from the right side. Such a chute puts the coarse coal on the left-hand side and the fine on the right-hand side. An improperly operated weigh larry can produce the same result. With any of the above arrangements or with any other arrangement that segregates the coal in this manner the fire will burn short where the coarse coal is and long where the fine coal is. Where the fire burns short, the CO_2 will be low and where it burns long, the combustible in the ash will be high. Hence efficiency and capacity are much reduced.

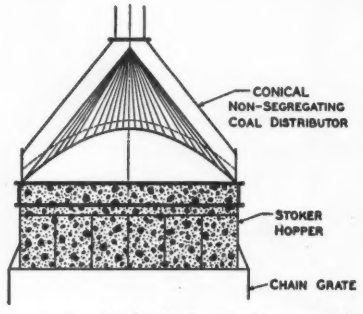

Fig. 3. Stock's sketch showing how correctly designed distributor prevents coal segregation

Solution to this problem is to install a conical non-segregating coal distributor as shown in Fig. 3. This coal distributor is designed to give a uniform mixture of fine and coarse coal across the stoker hopper. This is the only stationary means that will accomplish this result. With this distributor, CO_2 should be higher and combustible in the ash should be lower. It should also be possible to burn slack coal satisfactorily. There would be a considerable cost saving with the finer coal.

ARTHUR J. STOCK
Cleveland, O. Stock Eng'rg. Co.

Answer No. 250

How Stop Fuel Waste in This Unit Heater System?

A GREAT MANY interesting comments have been received on this problem, first published in the February issue. The problem was to decide the best way to prevent frequent blowing down of boilers (and resulting fuel waste) caused by the fact that returns from unit heaters operating at 75-100 psi come back to vacuum pumps so hot that large amounts of cold water have to be fed into the condensate return lines, also the pumps have trouble handling the hot condensate.

A number of engineers commenting on the problem feel that low pressure steam should be used in these unit heaters rather than high pressure steam. Others have pointed out that if high pressure steam is used, there is no need for the vacuum pumps and have shown how these pumps can be bypassed.

In considering low pressure versus high pressure steam for the unit heaters, as we pointed out to H. E. S. in our original reply to him, an important factor is the effect of steam pressure on the heating capacity of the heaters. This is emphasized particularly in the following comment.

Effect of Steam Pressure on Unit Heater Capacity

I WISH to comment on the interesting discussion under Answer No. 250 "How To Stop Fuel Waste In This Unit Heater System"; particularly Edward W. Gray's letter.

Mr. Gray states the proper solution would be to supply steam at reduced pressure IF the lines are big enough for the steam volume required. There is another equally important "if" concerning heater capacity that is not covered by Mr. Gray. The number of heaters installed and their capacities were no doubt, originally selected on the basis of the use of 75 to 100 psi operating pressure. Attention should be called to the fact that the condensing (heating) capacity of the heaters is sharply reduced with decrease in pressure. For example, a heater having a rated output of 450,000 Btu per hr at 75 psi steam will deliver approximately 300,000 Btu per hr with steam at 2 psi. This constitutes a respectable decrease in heat output which cannot be overlooked.

Specifically, the steam pressure cannot be reduced without augmenting the number of heaters if the inside temperature and building heat loss are to remain constant.

Baltimore, Md. ROBERT K. LEILICH

EDITOR'S NOTE: Mr. Leilich's point is well understood by heating engineers and has been thoroughly investigated. The results have been plotted and tabulated and, to reinforce Mr. Leilich's comment, we give here a few typical values taken from Table 1, pages 430 and 431, ASH&VE Guide, 1943.

Taking standard conditions to be 2 psi gage steam pressure and 60 F temperature of air entering the unit heater, the rating of a heater is called unity or 1.00. The table gives constants by which the rated capacity at standard conditions is to be multiplied to get the capacity at any steam pressure and entering air temperature. For example—

Steam Pressure psi gage	Temperature of Entering Air, Degrees F		
	40 F	60 F	90 F
0	1.110	0.956	0.739
2	1.155	1.000	0.782
10	1.290	1.131	0.908
20	1.416	1.251	1.024
50	1.666	1.498	1.262
75	1.808	1.635	1.392
100	1.927	1.749	1.502

As Mr. Leilich rightly points out, this question of the heater capacity must be taken into account in any discussion of this problem. This point is also mentioned by William T. Estlick, N. T. Pef and one or two other men.

Yeates Suggests a Two-Stage Unit Heater Hook-up

A PLANT with a 100 per cent heating load offers an opportunity to operate at very high efficiency, but to accomplish this result both design and operation must be good. In this case the engineer is struggling along the best he can with the installation he is given to operate.

The main advantage to be obtained by operating on low pressure would be a lowering of condensate temperature, preferably below flash temperature at the vacuum pump. Changing to low pressure would involve purchase and installation of reducing valves and complete replacement of high pressure piping with low pressure piping, large enough to handle the greatly increased volume of the steam. Costs and priorities would make the project unfeasible at this time.

On this type of system, the use of vacuum pumps is "gilding the lily," for a vacuum is difficult to maintain on high pressure return system and does not seem to exist at this plant. Lower the hot well if necessary, but pipe all returns direct to the hot well and eliminate the vacuum pumps.

It is necessary to maintain return temperatures low enough at the hot well to prevent waste due to flash steam. This could be accomplished by providing a two-stage effect at the unit heaters. In each group of four heaters (approx.) one could be cut out and the trapped returns from the three heaters discharged through the fourth heater. The second stage heater could be piped direct to the return line without trapping. The latent heat of flash steam and the excessive sensible heat of the condensate could then be salvaged from waste and a comfortable hot well temperature maintained. All piping involved is uninsulated and of relatively small size and is obtainable under the priority system.

San Francisco, Calif. ARTHUR YEATES

Coughlin Advises Low Pressure, or Using Part of Returns in Radiators

IN THIS question you do not explain whether or not the exhaust steam from the vacuum and feed pumps is used for heating or returned to the feedwater tank or let out into the out-of-doors. However, I do not agree with the operating engineer in his idea that the plant cannot be heated on low pressure steam. Provided all piping is installed properly, it also does not seem that it is good engineering practice to carry high pressure steam to run vacuum and feed pumps just for heating purposes.

I would suggest a good quality reducing valve placed on the main header and connected to the heating header; then by careful observation, the pressure can be cut down to the proper value to insure proper heating. It is also not good practice to introduce raw city water into the system due to its chemical effects on the boilers and piping. One other method he might try is to take the returns from about two-thirds of the unit heaters farthest from the boil-

HOW TO MAKE STEAM COSTS "STAY LICKED"

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ers and pipe it into radiators nearest to the boilers, using them as hot water units. Thus he should not have to use very much makeup water once the system was balanced.

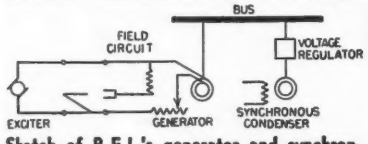
As to flooding of the boilers, it seems to me that the man in charge is very much at fault that he does not keep better watch of his feed pump adjustments. However, there are probably more angles to his woe that he has overlooked in his very brief description of his troubles.

Binghamton, N. Y. W. R. COUGHLIN

Answer No. 252

What Will Happen to the Megavars—and Why?

IN THE March issue, R. F. L. asked what would happen, in the system shown in the accompanying sketch, to the megavars or reactive kva of the synchronous condenser if the field strength



Sketch of R.F.L.'s generator and synchronous condenser connections. How would generator field manipulation affect condenser megavars?

of the generator is adjusted to make the generator reactive kva leading instead of lagging.

Here is a discussion of it that arrived in time for this issue. Others came in just too late for it, including some vector analyses of the conditions. These will be published soon, possibly as a separate article in P. E. & E.

Conditions in System Including Two Synchronous Machines

SINCE R. F. L.'s question is stated in terms of megavars it may be well first to explain the meaning of this term for the benefit of readers who may not be familiar with it. One megavar equals 1000 kilovars and "kilovar" is a term adopted in recent years and meaning the same as "reactive kilo-volt-amperes" or "reactive kva". Thus one megavar equals 1000 reactive kva. In conformity with more common practice, the term "reactive kva" will be used hereinafter.

In R. F. L.'s plant, a generator and a synchronous condenser are connected in parallel on a common bus from which power is distributed to the load. The generator furnishes the kilowatts required by the load while the lagging reactive kva required by the load is furnished partly by the generator and partly by the synchronous condenser. The reactive kva supplied by the synchronous condenser is ordinarily read on switchboard instruments as leading reactive kva flowing from the bus to the synchronous condenser. But, for more convenience in discussion of flow of reactive, it may preferably be referred to as lagging reactive kva flowing from the synchronous condenser to the bus. At the bus, the lagging reactive kva from the synchronous condenser joins with the lagging reactive kva from the generator to comprise the total lagging reactive kva required by and flowing into the load.

Using the term "reactive kva" instead of "megavar" and referring to only lagging reactive kva as suggested above, R. F. L.'s question becomes "What would happen to the synchronous condenser, as far as the amount of lagging reactive kva delivered by it to the bus is concerned, if the field strength in the generator is reduced to a value at which lagging reactive kva flows from the bus into the generator instead of from the generator to the bus "

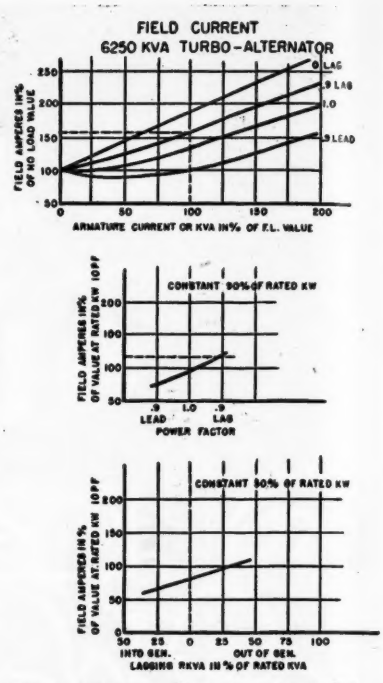
Before reducing the generator field, the lagging reactive kva delivered by the synchronous condenser to the bus would be the difference between the total lagging reactive kva required by the load and the amount of lagging reactive kva delivered by the generator to the bus. After reducing the generator field the lagging reactive kva delivered by the synchronous condenser to the bus would be the total lagging reactive kva required by the load plus the lagging reactive kva flowing from the bus to the generator.

As a result of the reduction in generator field mentioned in R. F. L.'s question, the reactive kva (or megavars) on the synchronous condenser would be increased by the amount of lagging reactive kva previously delivered by the generator plus the amount of lagging reactive kva received by the generator after reduction of its field strength.

The amount of lagging reactive current flowing from the bus into the generator is part of the total lagging reactive kva flowing from the synchronous condenser to the bus and constitutes a circulating current between the two machines, which adds to the losses and heating of both machines and produces no useful result. Such a condition is obviously undesirable and could not be considered a normal condition. However, shifting all of the lagging reactive kva to the synchronous condenser and operating the generator at zero reactive in order to carry a maximum kilowatt load on the generator may be desirable at times of heavy load, provided the synchronous condenser has sufficient capacity to carry all of the lagging reactive kva required by the load.

The total lagging reactive kva required by the load is normally divided between the two machines in proportion to the amounts of field current applied to the respective machines. All or part of the lagging reactive kva load on one machine may be shifted to the other machine by reducing the field current on the first machine or increasing the field current of the second machine or both. Since the bus voltage is proportional to the combined excitation of the two machines, reduction of the field current of one machine must be accompanied by increase of field current of the other machine if the bus voltage is to be kept unchanged.

To maintain constant bus voltage, the total combined excitation of the two machines must be varied in proportion to variation in the total lagging reactive kva required by the load. This is automatically accomplished by voltage regulators or is effected by manually adjusting field current to maintain constant voltage. If shifting of lagging reactive kva from one machine to the other is carried beyond the point where one machine carries zero reactive, there will be a reversal of lagging reactive kva flow in that one machine, so that the condition described in R. F. L.'s question will be obtained.


FIELD CURRENT
6250 KVA TURBO-ALTERNATOR
1.0 LAG
.9 LAG
1.0
.9 LEAD
FIELD AMPERES IN% OF NO LOAD VALUE
ARMATURE CURRENT OR KVA IN% OF F.L. VALUE
CONSTANT 90% OF RATED KW
FIELD AMPERES IN% OF VALUE AT RATED KW 1.0 PF
.9 LEAD
1.0
.9 LAG
POWER FACTOR
CONSTANT 90% OF RATED KW
FIELD AMPERES IN% OF VALUE AT RATED KW 1.0 PF
INTO GEN.
OUT OF GEN.
LAGGING KVA IN % OF RATED KVA

Curves showing conditions in system including two or more synchronous machines, illustrating discussion by Robert E. Burlingame. Top—curves for 6250-kva unit from Fig. 42, page 652, Standard Handbook for Electrical Engineers, 7th Ed. Middle and bottom—curves derived from top curves

The generator field current in R. F. L.'s plant is manually adjusted and consequently the generator will carry a fixed amount of lagging reactive kva as long as no readjustment of field current is made and the bus voltage does not change. The remaining part of the lagging reactive kva required by the load is carried by the synchronous condenser and will vary in accordance with variation in the total lagging reactive kva required by the load. The synchronous condenser has a voltage regulator whereby its excitation will be automatically varied, so that its excitation plus the fixed excitation of the generator will always add up to a total excitation which will produce the bus voltage for which the regulator is adjusted. As the total lagging reactive kva required by the load varies, the excitation on the synchronous condenser will thus vary so that, under normal operating conditions, the lagging reactive kva on the synchronous condenser will always be the difference between the total required lagging reactive kva and the fixed amount of lagging reactive kva furnished by the generator.

Minneapolis, Minn. ROBERT E. BURLINGAME

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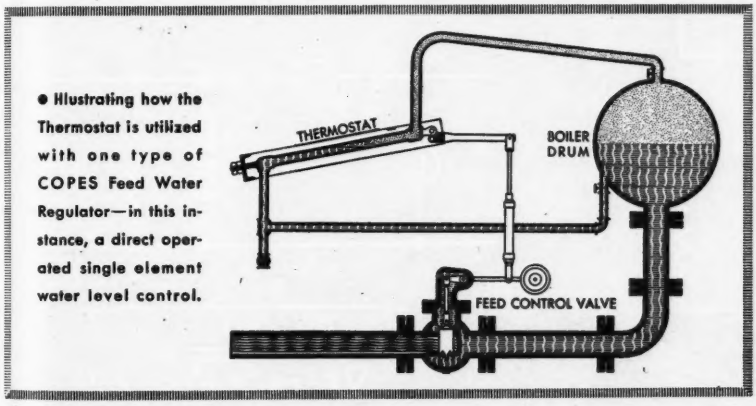
Aggressive research for 35 years has failed to uncover any other device as ideal for the purpose.

True, many mechanical improvements have been made. Frequently there are new adaptations to solve specific problems. Several styles are available for different types of COPES Regulators. But fundamentally the COPES Thermostat is still unchanged and unequalled.



● Illustrating how the Thermostat is utilized with one type of COPES Feed Water Regulator—in this instance, a direct operated single element water level control.

How It Operates

An inclined metal tube is mounted between two channels of a rigid steel frame. One end of the tube is anchored to the frame; the other end is attached to an angle type lever.

The interior of the tube is connected to the boiler drum similar to a water column, steam filling the upper part, and water the lower part. Corresponding water levels always exist in the tube and the boiler.

The water filled part of the tube is relatively cool due to radiation. Therefore when the water level lowers, permitting more hot steam to enter, the average temperature of the tube increases. The tube *must* expand. Conversely, with a rise in water level, the tube *must* contract. This movement, amplified by the lever, operates the feed water control valve either by direct mechanical transmission or by pilot valve fluid transmission.

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3. FULLY AUTOMATIC. Repeats performance continuously without periodic attention.

4. POWERFUL. Recall your own experiences with the tremendous forces developed by expansion and contraction.

5. RESPONSIVE. Grasp a pipe and shoot live steam into it. How quickly will you let go? Tests prove the COPES Thermostat responds to level changes 5 to 8 times faster than other devices.

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10. ADJUSTABLE. Nuts at the fixed end of the tube permit easy adjustment of water level setting *with the regulator in service.*

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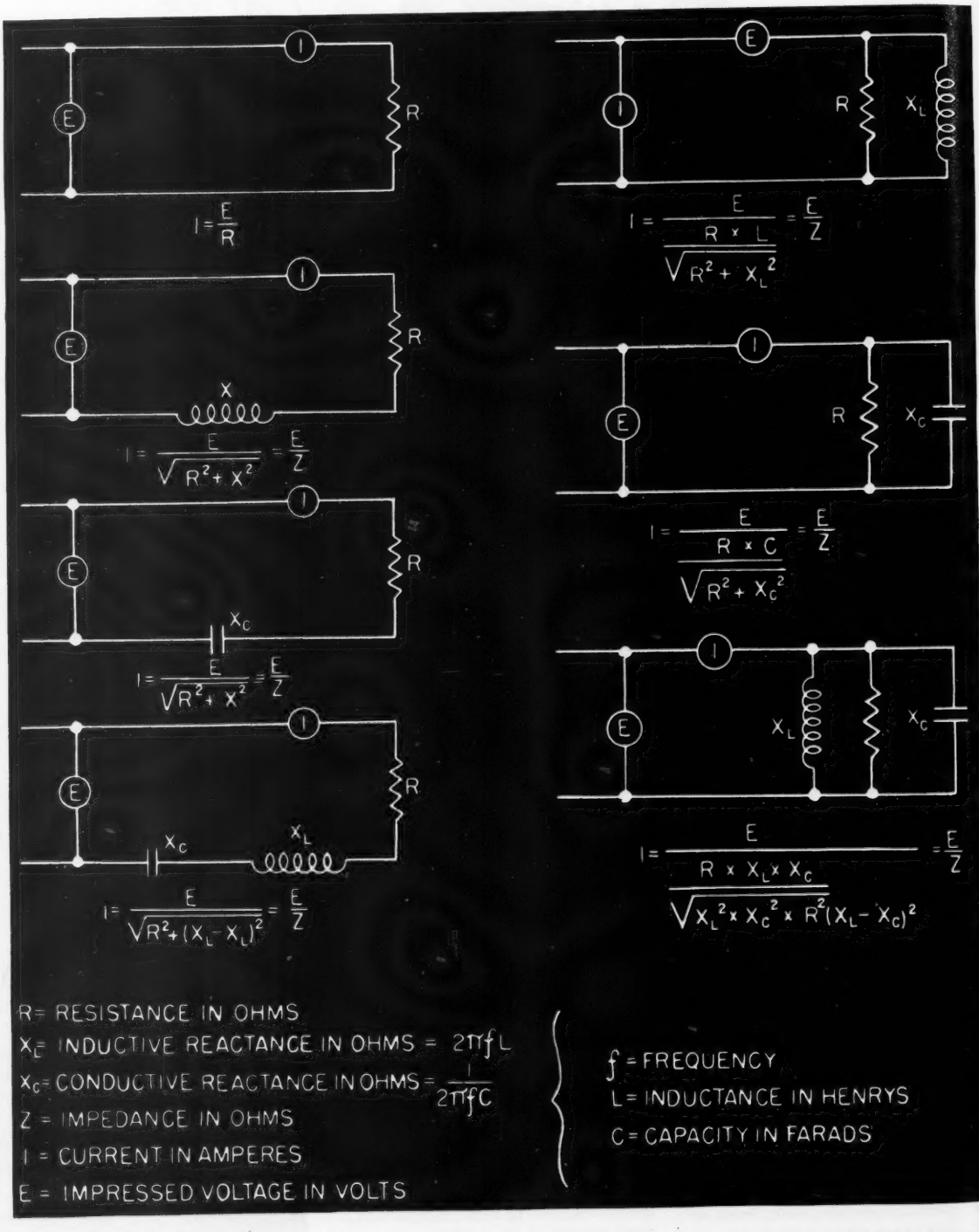
Formulas for Determining Current in A-C Circuits


I
E
R
$I = \frac{E}{R}$
X
$I = \frac{E}{\sqrt{R^2 + X^2}} = \frac{E}{Z}$
X_C
$I = \frac{E}{\sqrt{R^2 + X^2}} = \frac{E}{Z}$
X_C
X_L
$I = \frac{E}{\sqrt{R^2 + (X_L - X_C)^2}} = \frac{E}{Z}$
$I = \frac{E}{\frac{R \times L}{\sqrt{R^2 + X_L^2}}} = \frac{E}{Z}$
$I = \frac{E}{\frac{R \times C}{\sqrt{R^2 + X_C^2}}} = \frac{E}{Z}$
$I = \frac{E}{\frac{R \times X_L \times X_C}{\sqrt{X_L^2 \times X_C^2 \times R^2 (X_L - X_C)^2}}} = \frac{E}{Z}$
R = RESISTANCE IN OHMS
X_L = INDUCTIVE REACTANCE IN OHMS = $2\pi f L$
X_C = CONDUCTIVE REACTANCE IN OHMS = $\frac{1}{2\pi f C}$
Z = IMPEDANCE IN OHMS
I = CURRENT IN AMPERES
E = IMPRESSED VOLTAGE IN VOLTS
f = FREQUENCY
L = INDUCTANCE IN HENRYS
C = CAPACITY IN FARADS

The formulas and diagrams shown on this chart will be found useful in alternating current wiring calculations. It is simple enough to calculate the current in a direct current circuit if the voltage and the resistance is known by the simple application of Ohm's Law but Ohm's Law does not hold for alternating current circuits except where the circuit contains only resistance. When inductance or capacity is present in alternating current circuits Ohm's Law has to be modified to take account of the inductive and capacity reactances. The diagrams, above, show a number of circuits with various combinations of resistance, inductance and capacity together with the proper formulas for calculating the current. These formulas and diagrams are abstracted from Volume I of Maintenance Hints published by Westinghouse Electric & Mfg. Co.

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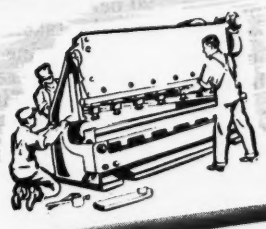

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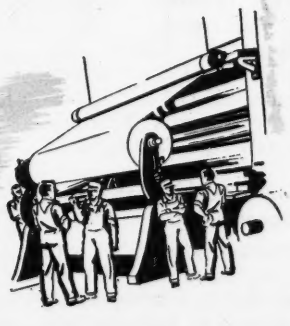

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Diesels of New Design by Hendy

(*Continued from page* 102)

tubing. Pyrometer thermocouples are located at the lower sides of each exhaust outlet. Cylinder-head water thermometers are also provided.

Bearings and Lubrication

The large-diameter crankshaft may be either a solid steel forging or a hollow alloy casting. The forged steel crankshafts are drilled for force-feed lubrication to connection-rod and wrist-pin bearings. Alloy cast crankshafts are for lubrication to rod and pin bearings.

By a unique design, full bearing area is obtained on the upper side of the connecting rod and lower part of main bearings. The main bearings are centrifugally cast, babbit-lined, steel-backed type. Each bearing is easily removed without disturbing crankshaft or other bearing caps. The center main bearing is 6⅝ in. long, with others 4⅝ in. long. All are 9 in. diam.

Two main bearings are located at the flywheel end of the crankshaft. Between them is the camshaft and governor driving gear. The camshaft drive chain is in two sections, of which the first connects the driving sprocket and the shaft of the chain-adjustment assembly, and the second goes from the chain-adjustment assembly to the camshaft. Uniform tension can be maintained without altering timing.

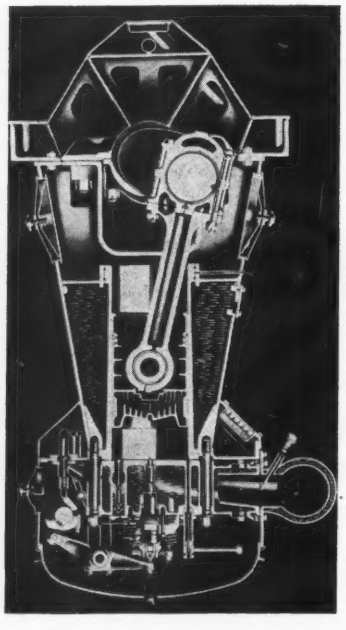

Fig. 3. Cross-section, end view, cut-away showing further details of construction

Oil cooling reduces the weight and operating temperatures of light-weight cast Meehanite pistons, which contributes to longer ring and liner service and reduced oil consumption. Pistons have deep ribbing on the underside of the head. Bronze wrist-pin bushings are pressed into pistons.

Connection rods are forged steel, with small ends fitted with removable hard-alloy bronze bushings. Big ends have removable split babbit-lined bearings. Caps are held to the rods by four alloy steel bolts. Rods are drilled for force-feed lubrication of wrist pins and to provide the oil for piston cooling.

Full pressure lubrication is used with a scavenging pump to remove oil from the crankcase to an external reservoir, and a separate pressure pump to supply oil from this tank through a header to the main bearings and through the drilled crankshaft to rod bearings and pistons. Camshafts, rocker arms, accessories and other parts are supplied by individual lines.

A positive automatic system of lubrication is provided which takes away the dangers of manual lubrication and prevents dilution. A positive oil supply is provided by the main lubricating system. Main bearing, crankpin bearings and piston pins receive a continuous supply of oil. This is augmented by a secondary system which provides oil for the rocker-arm pivot, rocker-arm bearings, ball joints and cam followers.

Starting Mechanism and Speed Control

Each cylinder is provided with an air starting valve, to which air is admitted by a corresponding pilot valve driven by the camshaft. Air requirements are cut to a minimum by this method. The cage-type relief valve is so designed that it can also be used as a compression release through manually operated cam action that opens the valve. Provision is also made on each relief valve for attachment of a pressure indicator.

Speed is regulated by a mechanical or hydraulic governor. On marine models, the entire speed range is governor controlled. The governor drive is through gears from the flywheel end of the engine. Starting and operating controls are centralized at the gage board, where reversing mechanisms for marine engines are also located. The gage board has tachometer, fuel, lubricating-oil and air-pressure gages and pyrometer.

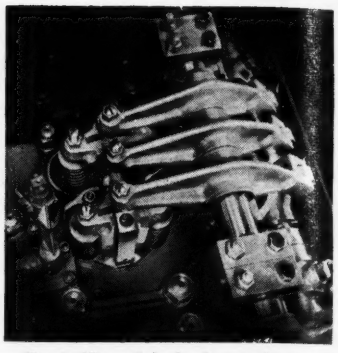

Fig. 4. View of dual valve mechanism

For power take-off, a friction clutch is provided as optional equipment, at opposite end of engine from flywheel. Power up to 20 per cent of the rated horsepower may be taken from this clutch.

In marine installations, both direct and reduction-gear drive models have Timken marine thrust-bearings, force-feed lubricated from engine, and built either as integral parts of the engine or reduction gear. Hendy planetary-type reduction gears or Farrell-Birmingham continuous-tooth single reduction gears are available as optional equipment. A flexible coupling is provided between the flywheel and reduction gear in either model.

Preventive Motor Maintenance

RULES FOR preventive maintenance suggested by the Reliance Electric & Engineering Co. have been condensed almost to the brevity of the "stop, look and listen" so familiar at railroad crossings. Certainly the next thing to it, the maintenance suggestions made consist of four admonitions—

LOOK — For oil, water, coolants, etc., that may be dripping or splashing onto windings . . . oil leakage from bearings . . . oil ring turning . . . poor commutation (on d-c) . . . loose springs on brushholders . . . obstructions to ventilation.

LISTEN — For slipping belts . . . noise due to loose pulleys, gears, couplings . . . noise due to rough commutator.

FEEL—For abnormal heat . . . vibration . . . condition of commutator.

SNIFF — For overheated insulation . . . injurious fumes.

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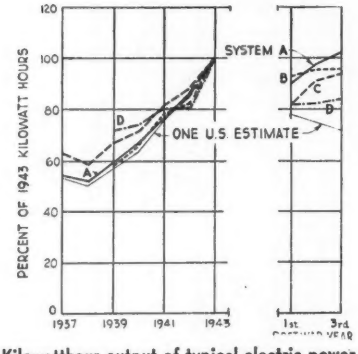
Midwest Power Conference Views Progress

Attendance exceeded all previous records; utility load predictions revealed; problems of operator discussed; interest shown in electronic controls

ON APRIL 13 and 14 time was taken by more than 2000 engineers of various types interested in power development and its industrial uses to attend sessions of the Midwest Power Conference, and to learn of recent progress in the field and future possibilities. Attendance this year was the largest in the history of the Conference which is now directed by Stanton E. Winston of the Illinois Institute of Technology and sponsored by nine midwest universities and colleges with the cooperation of the principal engineering societies represented in the midwest area.

The scope of the program was broad in the sense that papers dealt with nearly every phase of the power industry, yet the treatment of the subjects got down into details in a way designed to be helpful to the scientist, the designer, the engineer and the plant owner. Several papers dealt with the power industry in general, others with steam power, Diesel power, electrical equipment, fuels, maintenance and purely scientific problems. No attempt will be made in this general report of the Conference to abstract or even brief the papers presented, for all the papers on the program have points of interest to engineers in the power field and will appear in full in the Proceedings of the Conference. Readers, however, can get an idea of the character of the papers presented from the accompanying list of subjects and the brief outlines accompanying them. Comprehensive abstracts of several of the most important papers will be published in later issues of POWER PLANT ENGINEERING.



Kilowatthour output of typical electric power systems in relation to 1943 data

Power Industry Today and Tomorrow

With nearly 70 per cent of the power used in industry supplied by electric utilities and the war industries requiring over 40 per cent of all the utilities' output, the country has climbed the hill to the point of maximum war production. It is now time, in the opinion of A. D. Bailey, assistant to the vice president, Commonwealth Edison Co., that "with the end of the war approaching in the not too far distant future, and recognizing conditions as they are, the electric utilities must now look forward to the years to come when this war activity will cease and when industry and civilian life itself will get back to a normal peace time basis."

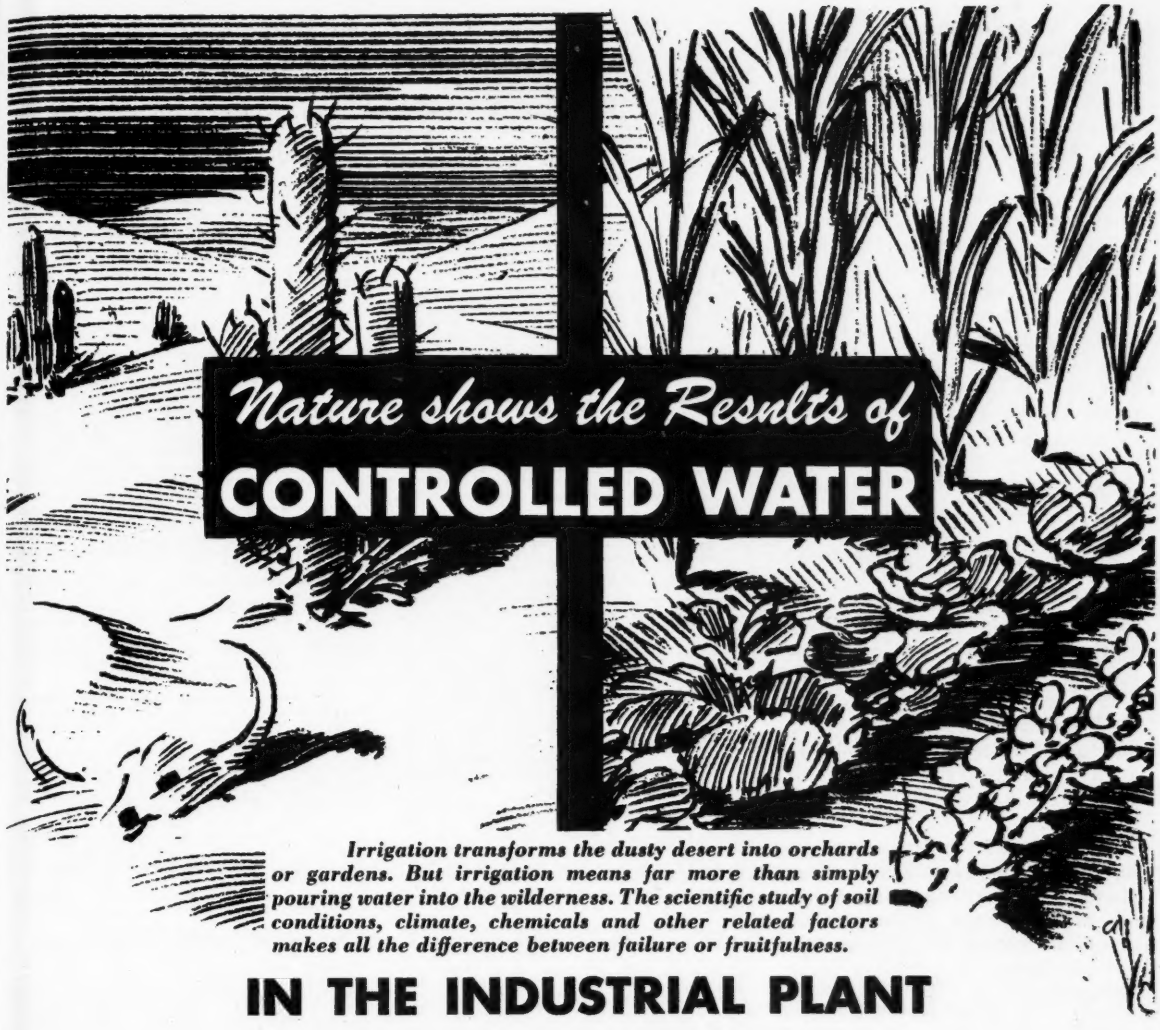
More machinery and more power, he contends, will be required to increase the output of the industrial worker above prewar levels and thus continue to raise our standard of living. The horsepower per worker in factories nearly doubled in the twenty years from 1919 to 1939. The war has given a tremendous impetus to this increase of power and output per individual. The index of industrial production has risen from about 130 to 250 from July 1940 to 1944 while the number of workers in industry has increased only from 28.6 million to 32.7 million.

Estimates of the probable trend of sales of electric power in the immediate postwar period made by electric utilities throughout the country all indicate some drop in kilowatthour output during the conversion period immediately following the war due to low industrial use while converting to peace time products. One of the most optimistic estimates shows that the kilowatthour output in the third postwar year will be greater than in 1943, another anticipates a drop of 18 per cent below the 1943 figure with a slow recovery. An estimator for the entire nation is so pessimistic that he predicts a drop of 22 per cent below 1943 in the first year and a further drop of 6 per cent by the end of the third year, after which a steady recovery is predicted.

Government action has necessitated careful and continuous study of trends in loads which have been divided into five classes: rural, residential, commercial, industrial and railroads. The plans of all classes of users are being studied to indicate load trends in the postwar period. The studies of the Commonwealth Edison Co. point to a complete load recovery in the third year after the war, according to Mr. Bailey.

As director of the WPB's office of war utilities, J. A. Krug, who addressed those at the All Engineers' Dinner, has had intimate contact with the use of power for producing war materials, controlling not only distribution of power to the various industries, but the allocation of power equipment to the various power plants throughout the country. He spoke of electric power as a universal need in industrial plants which are now heavily engaged in producing equipment for the mechanized war in which we are engaged. High praise was given to the private utilities for the cooperation given the Government in its efforts to prevent a shortage of power for any essential industry. The utilities helped to conduct surveys of power resources, estimate power requirements of war industries, conduct power pools, schedule maintenance work, carry through conservation programs and in every way possible support the work of the WPB to the end that power supply has never failed to keep pace with war production.

He is of the opinion that plans for the future should include a study of the industrial facilities in the areas surrounding power industries, that attention should be directed toward mass distribution of electric appliances at low cost to the public, and that cooperative planning should be developed between power men, industry and Government agencies to make certain that electricity is practically applied to its various possibilities in industry, commerce and in the home.



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Steam Power

Without question, steam power still maintains first place in the field of power generation and many problems remain to be brought to a completely satisfactory solution. From the economic standpoint, manufacturers and some users are giving study to the development of standard designs of turbo-generators in the hope that by following these standards the cost of these units can be materially reduced and at the same time maintain operating efficiency. The pros and cons of the controversies which are taking place in the discussion of this proposed action were brought out by M. S. Oldacre and took the form of a progress report without an expression of definite conclusions.

The difficulties encountered with priming and carryover are as old as boilers, and they still persist, though in lesser degree and modified form. Study of the problem has been renewed as a result, more than likely, of increased boiler loads in war production plants. The operator can do a lot to prevent this trouble and when it does occur it is his headache.

Corrosion is the principal destructive force at work in power plants and metallurgists are working with various phases of the problems involved. At this conference there was considerable information given regarding methods of corrosion and inhibition which should clear up some of the troubles with piping and condenser tubing.

In the electrical field, transformers were given some much needed attention, since in recent years many developments have taken place not only in design but in installation which have increased the operating efficiencies and lengthened the life of transforming equipment. Some things are also being found out about the deterioration of insulation used in transformers which the operators should know about. The developments along this line are well worth following.

Although the older methods of control by means of electrical currents are well understood by power engineers, their application is not as general as many would like to see and every year new applications come into being which recently have helped to relieve the manpower situation. In addition to the older types of control, the application of electronic controls was given some discussion at the Conference with some emphasis on the danger of too great enthusiasm — expecting the impossible. Speakers advised engineers to study and thoroughly understand the principles of electronic devices as the field is in its infancy.

The term industrial control is applied to apparatus used to control power supplying motors, industrial heating, capacitors, resistance welding and the like. As indicated in the paper by E. H. Alexander, the electrical industries have concentrated their efforts on supplying instruments and controls for equipment used by the Army and Navy and the essential war industries, the problems of which are in many instances much more severe than those formerly met in industry. Successful application in these new fields has pointed the way to many improvements that will, no doubt, be incorporated into the designs of control equipment for peace-time industries.

Papers Presented at Midwest Power Conference

Postwar Planning of the Nation's Power Supply—A statistical survey of utilities' loads and capacities with projections into immediate postwar period, backed by data on services to various fields—By Alex D. Bailey, assistant to vice president, Commonwealth Edison Co.

Necessity for Research on Combustion Rates and Ash Behavior—Present methods of burning solid fuels are outlined, furnaces and boilers given consideration, present rates set by ash troubles and incomplete combustion, development of instruments needed to measure local furnace and fuel bed conditions—By A. R. Mumford, Combustion Engineering Co.

Review of Experimental Stress Analysis Methods — Description of experimental stress analysis instruments and equipment and methods of use as exemplified in modern scientific laboratories.— By C. O. Dohrenwend, Armour Research Foundation.

Progress Towards Standardization of Turbo-Generators for Central Station Service—Report of progress which has been made by society committees working with manufacturers and users; statement of problems encountered and reasons for decisions made. Paper not released for publication.—By M. S. Oldacre, Commonwealth Edison Co.

Causes and Prevention of Boiler Priming and Solids Carryover—Discussion of factors which cause entrainment of boiler water, and its attendant salts, in saturated steam leaving boiler drum, and methods of correction; carryover reduced by reducing boiler load and rapidity of load changes, by maintaining proper boiler water conditions, by providing satisfactory automatic feedwater and combustion regulation, by installing modern steam separating and purifying equipment in the boiler drum.—By W. H. Rowand, Babcock and Wilcox Co.

Maintenance Systems — Comprehensive description of a specific planned maintenance system from its inception to figures on manhours required for certain jobs; management of system stressed.—By Wm. A. Perry, Inland Steel Co.

Corrosion as a Factor in Piping Maintenance—Special reference given to the physical effects of fluid flow and other factors as closely allied to engineering as to chemistry: consideration given to corrosive effects of water, steam and other industrial liquids and gases upon metals used for piping.—By L. G. Vande Bogart, Crane Co.

Modern Transformer Developments and the Economic Trend—Design and installation methods recently employed to reduce initial costs and operating losses of modern power and distribution transformers; particular reference given to cooling methods. —By J. K. Hodnette, Westinghouse Electric & Mfg. Co.

Deterioration of Insulation in Oil Immersed Transformers—Factors affecting deterioration of insulation were enumerated; air or oxygen in oil is harmful, water likewise; effects of varnishes and resins discussed; modern protection methods and improved materials are improving life of transformers.—By F. J. Vogel, Illinois Institute of Technology.

Wartime Power Supply—A recital of measures taken by Government in cooperation with power industry to meet demands of war industries for electric power; limitations placed on plant construction; surveys of power resources; operation of power pools; services performed by barge power plants; war production never hampered by power shortage.—By J. A. Krug, Office of War Utilities, War Production Board.

Place of Electronics in Power Generation—An attempt to remove some of the mystery surrounding electronics and to clarify electronic methods; overeagerness should be avoided; proper application and proper design of equipment will give a major place to electronics in power generating field.—By J. D. Ryder, Iowa State University.

Corrosion Inhibitors—Corrosion may be stifled by the addition of a corrosion inhibitor either to the alloy or to the corrosive solution; mechanism of protection explained chemically; effectiveness of nitrogen compounds, proprietary inhibitors, oils, salts, arsenic and antimony compared; mechanism of inhibition explained.—By Austin R. Zender and C. L. Bulow, Bridgeport Brass Co.

Future Role of Oil Fuels—Future status of crude supply remains indefinite; Diesel fuels cannot be considered separately; between motor and Diesel fuels the refiner or marketer will decide in favor of gasoline; sources of Diesel fuels; ignition quality improvers; engines designed to operate on 45 octane number will find little, if any, trouble traceable to ignition.—By Arch L. Foster, Editor, The Oil and Gas Journal.

Statistical Comparison of Fuels—Comparison of proximate coal analysis is accomplished by use of a statistical discriminant function developed by Fisher; prediction of coal heat value is made by use of linear functions of proximate coal analysis.—By W. D. Baten and C. C. DeWitt, Michigan State College.

Developments in the Field of Control—Paper treats the control of power supplying motors, industrial heating, capacitors, resistance welding and the like; equipment covered includes control for shipboard installation, aircraft and tanks, industrial service and electronic devices.—By E. H. Alexander, General Electric Co.

New Applications of Mercury Arc Power Rectifiers—War stimulated development of electronic power equipment; production of aluminum, magnesium, chlorine, and steel called for nearly 2,500,000 kw of converting equipment; needs permitted mass production of rectifiers; various types described and their application indicated.—By W. E. Gutzwiller, Allis-Chalmers Mfg. Co.

Trends in Power System Analysis — A unique treatment of history of power system development; period divided into Golden Age, Empirical Age, Renaissance and Economic Age; hitherto neglected effects need to be understood and evaluated. —By Miss Edith Clarke, General Electric Co.

Ice Melting Practice on 132 kv Lines—Ice formation on lines may cause whipping, striking together, tripping out of a line, damage to steel towers; methods of minimizing effects; conditions leading to ice formation; calculation of currents required to eliminate ice; methods employed.—By H. A. Cornelius, Public Service Co. of Northern Illinois.

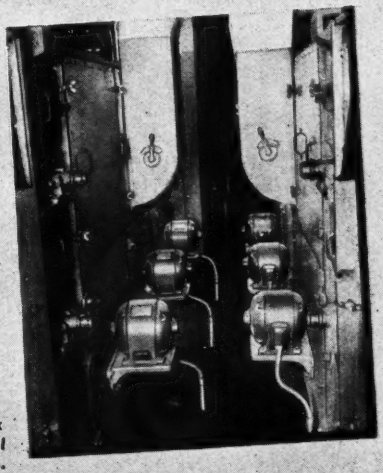
Visualizing Heat, Magnetic and Electrostatic Field Problems in Electrical Apparatus—A mathematical treatise employing geometrically constructed figures to visualize energy flow in space or liquid.—By J. F. Calvert, Northwestern University.

Evaporative Coolers for Diesel Engines —Basic facts about evaporative coolers, how they work, factors influencing their selection, installation details—By William Goodman, Trane Co.

Isolation of Vibration from Diesel Plants —Degree of isolation must be established; analysis of vibration disturbances must be made; spring stiffness must be calculated and type of suspension selected; individual mountings must be designed.—By H. H. Fink, The B. F. Goodrich Co.

WHEN THE HEAT'S ON

Motor-driven machinery is often called upon to operate under conditions of extreme heat and humidity. For example, the motors on this wool-plant washer must operate in an air temperature of 100° F., with humidity higher than 80 per cent. Conditions like this would shorten the life of any motor lacking effective, performance-tested ventilation design. The double-end cooling system of the Tri-Clad motor helps offset the effects of high ambient temperatures common to heaters, dryers, and many ventilating-fan applications. In addition, motor windings of Formex wire (Class A insulation) are unusually long-lived under total temperatures (ambient plus rise) up to 194 F. For even higher temperatures, Class B insulation offers still greater protection.



G-E Tri-Clad motors applied to Sargent back washers at plant of the Southwell Wool Combing Company, No. Chelmsford, Mass.

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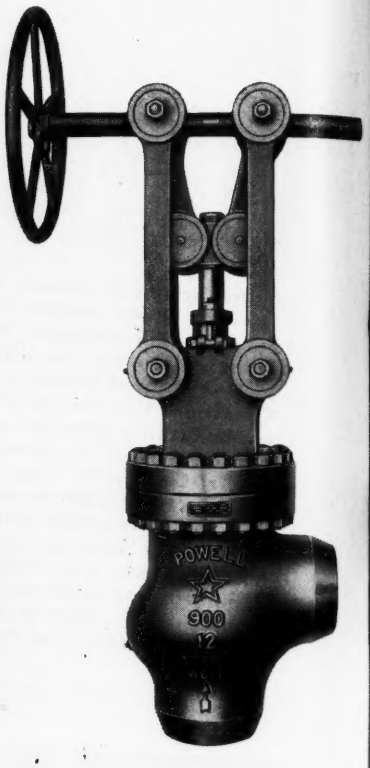

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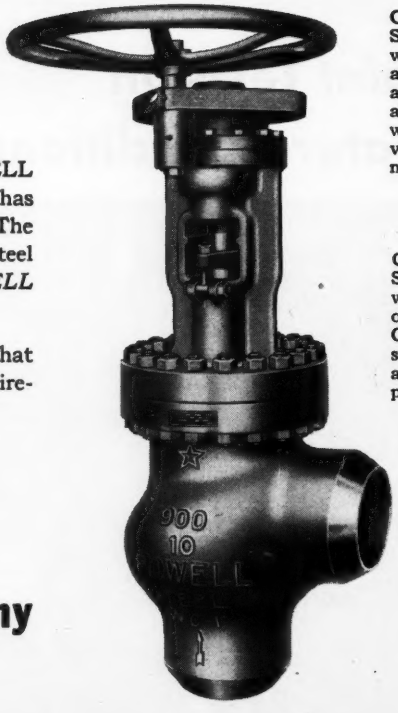

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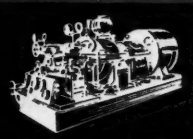
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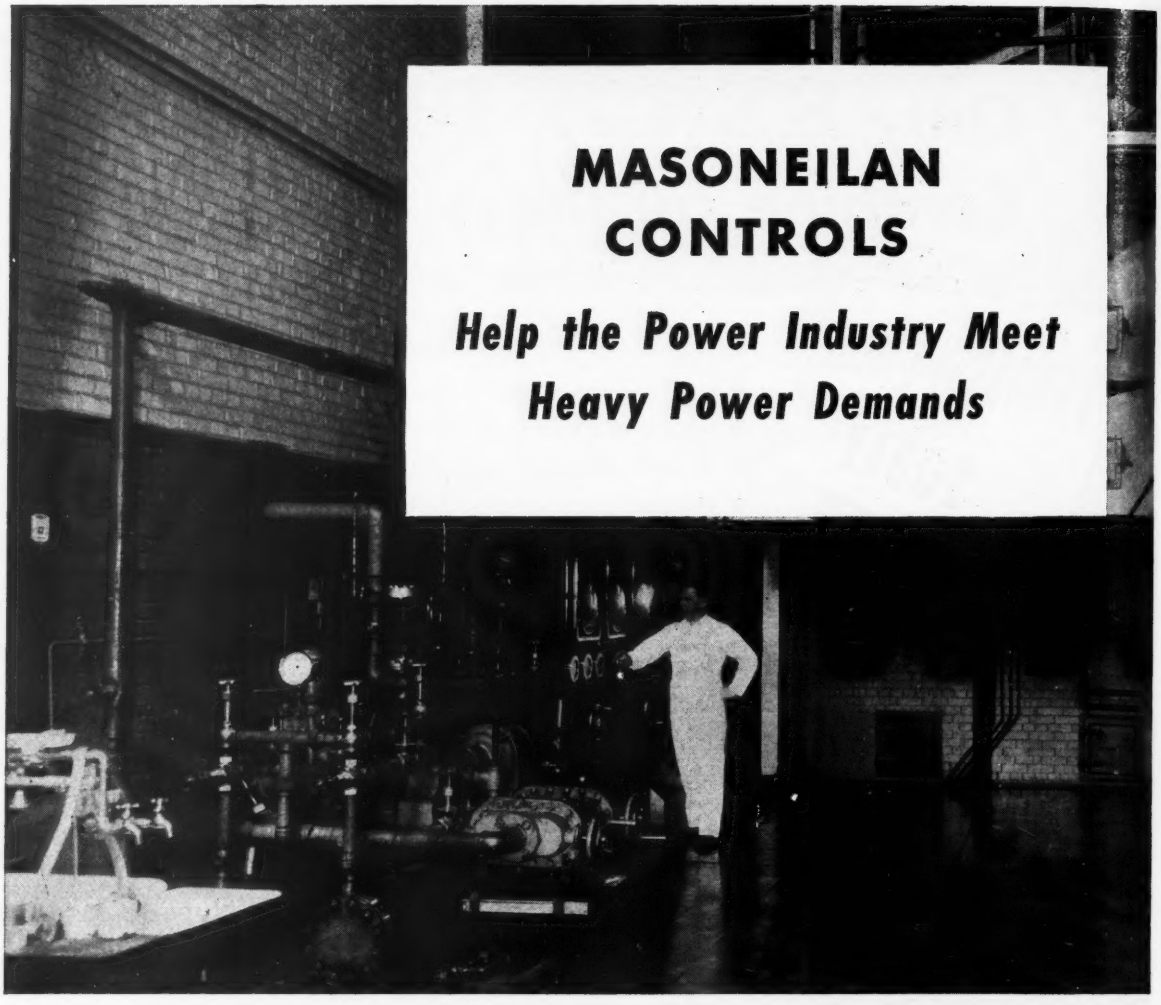

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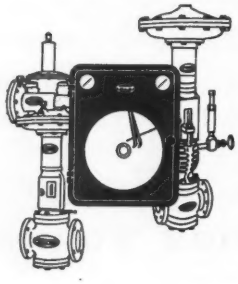

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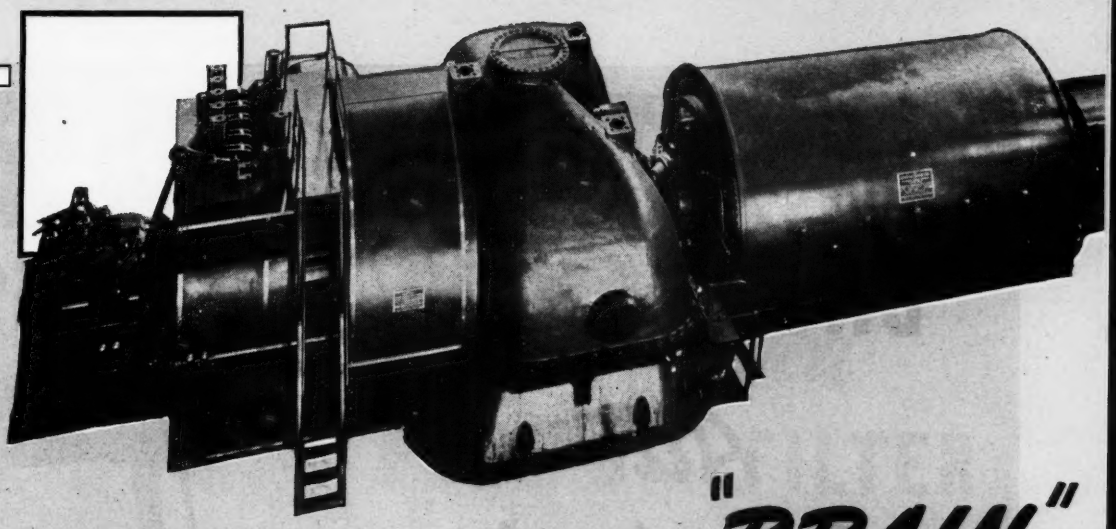

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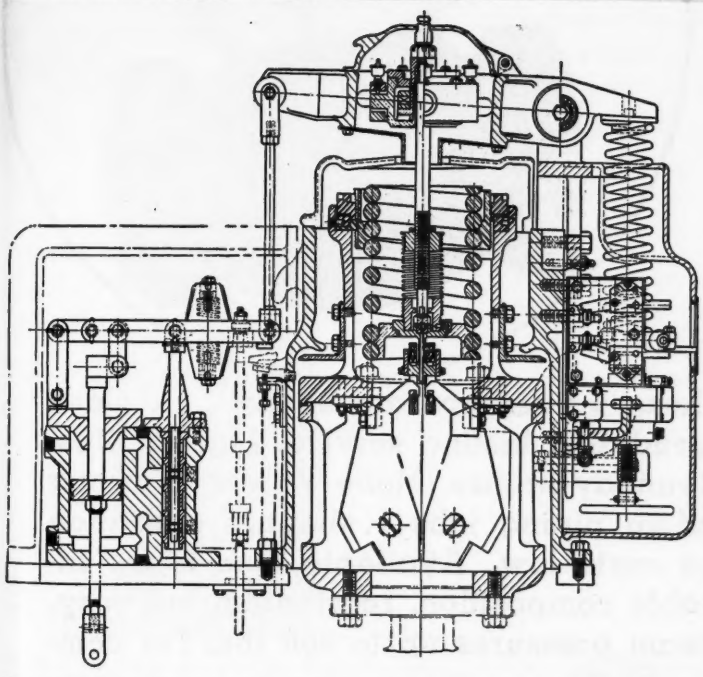

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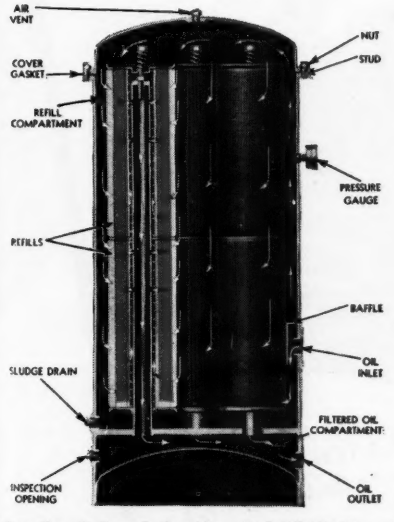
The improved DFR Series Briggs Fuel Oil Clarifier. Note the two gauges that enable the operator to observe at a glance the pressure differential across the filter.

Outer case and cover are of heavy gauge welded steel . . . hydrostatically tested to pressures well above working pressures encountered under operation. Compact design requires minimum floor space. Simple to install and service.



Follow the oil through the Briggs Fuel Oil Clarifier. See how it first passes through the cellulose (A) where solid impurities are ABsorbed, next—through the Briggs Patented Moulded Fullers Earth Block (B) where the invisible contaminants . . . gums, corrosive acids, resins . . . are removed by ADsorption and finally—again through cellulose (C) where even the minutest foreign particles are removed.

Improved refill holding assembly assures a perfect seal at ends of refills at all times—eliminates possibility of by-passing—provides uniform pressure over entire end of refill.

This new line of Briggs Fuel Oil Clarifiers provides a proved-efficient unit for every size and make Diesel engine . . . with flow capacities ranging up to 500 G.P.H. Every requirement for maximum efficiency has been anticipated by Briggs engineers . . . every possible feature has been incorporated in order to give your Diesel engine 100% protection against the hazards associated with unavoidably contaminated fuel oil.

Fuel lines will remain clean and unobstructed. The injector system will function more efficiently under this protection. You'll have fewer shut downs and lower operating costs.

Investigate these improved Briggs Fuel Oil Clarifiers. Learn why they are investments that pay for themselves in actual money saved. Complete specifications of all models on request. Custom-built models available for special applications. See the Briggs representative in your locality.

Briggs

PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER COMPANY

1339 WISCONSIN AVE., N. W., WASHINGTON 7, D. C.

REPRESENTATIVES IN PRINCIPAL CITIES

THE COST OF LEAKS
SIZE OF OPENING
AIR 100 LBS. PRESSURE
Cu. Ft. WASTED PER MONTH
COST AT 10c PER M.
STEAM 100 LBS. PRESSURE
LBS. WASTED PER MONTH
COST AT 60c PER M
WATER 40 LBS. PRESSURE
GAL. WASTED PER MONTH
3/8 9,979,200 $997.92 460,000 $276.00 692,400 $108.00
1/4 4,449,600 444.96 203,000 121.80 307,700 48.00
1/8 1,114,560 111.46 50,500 30.30 76,900
1/16 278,640 27.86 12,750 7.65 19,200
1/32 69,552 6.96 3,175 1.91 4,800
TIGHT VALVES STOP LEAKS — SAVE MONEY
USE DEXTER VALVE RESEATING MACHINES

You can see a lot through a PINHOLE

POWER PLANT Executives, for example, can see the loss of thousands of pounds of steam, air or water in a valve leak no bigger than the average pinhole.

In terms of pounds and money, a little $\frac{1}{32}$ inch valve leak can pile up real losses, as shown on the card. Here are the figures taken from long-term tests, based on normal pressures.

Larger leaks produce losses in far greater proportion than on a basis of comparative size. For instance, a $\frac{3}{8}$ inch leak brings a loss of 460,000 lbs. of steam, normally costing $276.00 a month!

Reseat the Valve the Easy Dexter Way

Losses in steam, air, water — and DOLLARS, by leakage, are only the *first costs*. Shutdowns, replacements and high labor costs follow . . . *unless* you are equipped with a Dexter Valve Reseating Outfit.

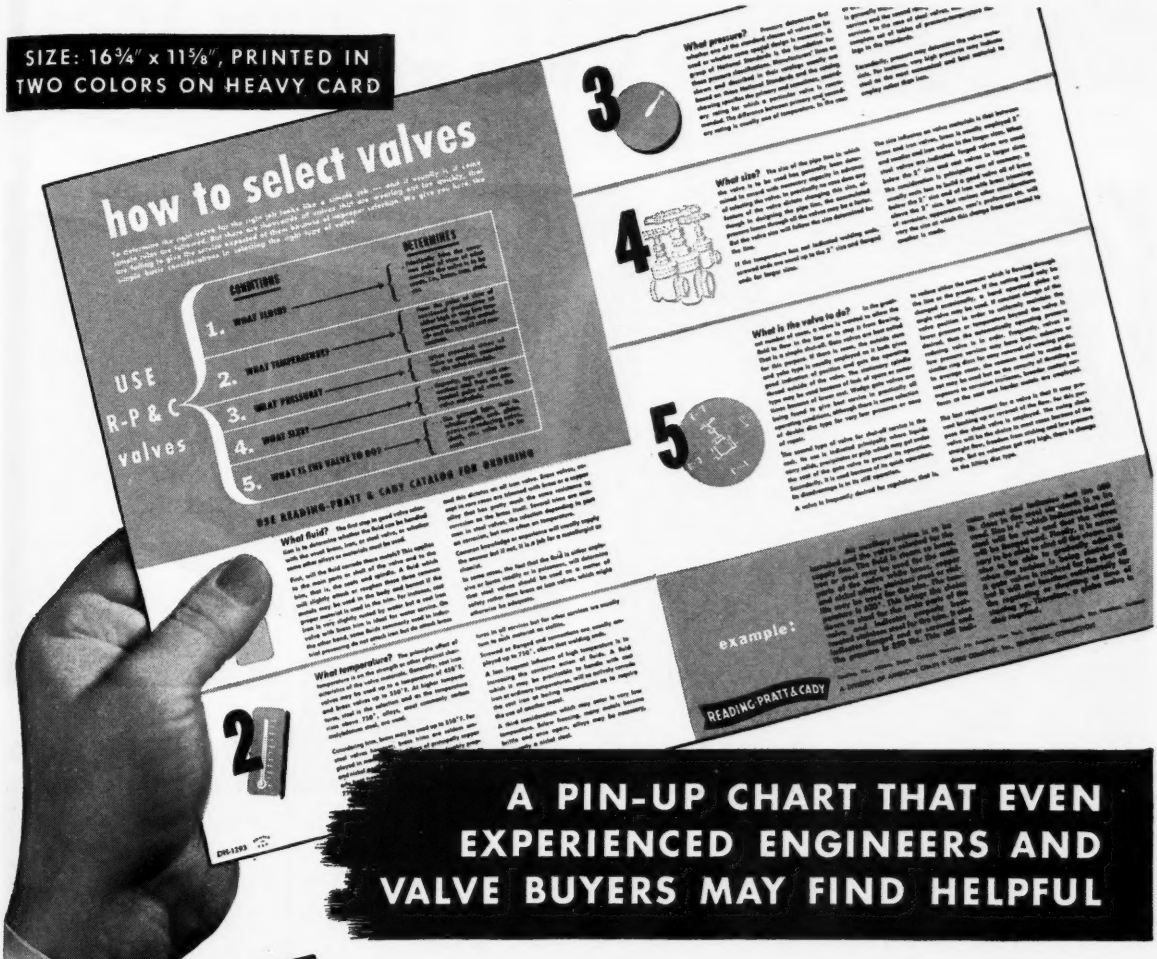
With Dexter equipment, your leaky valves can be reseated, in a few minutes, *right on the line*. One man can do the job, and your valves will be as tight as new.

Write us about your valve leaks. We'll give you complete information about the proper Dexter Reseating Machines and Cutters to take care of your valves — from now on.

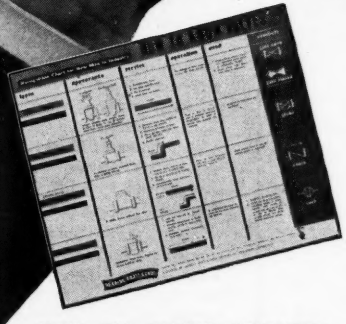
8

THE LEAVITT MACHINE COMPANY
ORANGE, MASSACHUSETTS

SIZE: 16¾" x 11⅝", PRINTED IN TWO COLORS ON HEAVY CARD



A PIN-UP CHART THAT EVEN EXPERIENCED ENGINEERS AND VALVE BUYERS MAY FIND HELPFUL



HOW TO KNOW VALVES

A companion chart to **"how to select valves."** Tells how to identify quickly gates, globes, checks and cocks. Shows their distinct differences in appearance, the services to which each is suited, how each operates and where each should be used. Address Reading, Pa. office for a copy.

This easily read chart 16¾" x 11⅝" covers the 5 major considerations that determine the selection of valves.

1. **The fluid, from a corrosive standpoint, determines whether the valve should be made of brass, iron, steel, etc.**
2. **Temperatures, from the point of view of continued performance, determine valve materials and end connections.**
3. **Pressure determines the standard class to employ; and, secondarily, valve materials.**
4. **Size determines valve capacity, end connections and valve materials.**
5. **What the valve is to do determines whether to use cock, gate, globe, check, pressure-reducing valve, etc.**

This data is compressed into the READING-PRATT & CADY chart **"how to select valves."** Experienced men will find it an excellent prompter when they are discussing valves, and new men in industry will find its information an invaluable guide. Copy sent gladly. Address our offices in Reading, Pennsylvania.

READING-PRATT & CADY

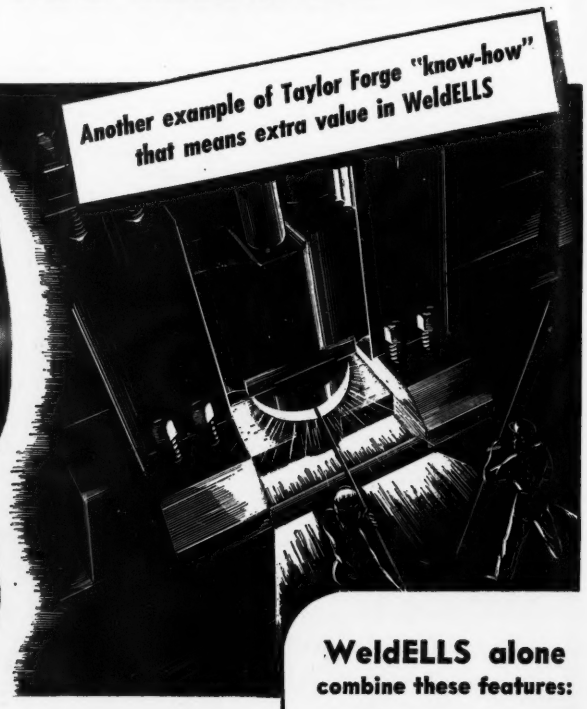
MANUFACTURERS OF

READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

Reading, Pa., Atlanta, Boston, Chicago, Denver, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco

A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, Inc., BRIDGEPORT • CONNECTICUT

ALL RIGHT . . . YOU NAME IT!



A side outlet tee? Hardly, because the included angle between the outlets is 120°. A cross? Well, what do you think?

Perhaps the best term would be "double branch tee". Anyway, it is formed seamless in carbon-moly—is 10" pipe size in the run with .605" wall, and 7" size in each branch with .429" walls.

This double-branch tee is just one of hundreds of examples of the endless procession of problems that we have tackled and solved across the years—many of them far more difficult than this.

No wonder, then, that we are able to give you extra values in our regular line of WeldELLS and other Taylor Forge welding fittings. There is nothing that can be desired in welding fittings which is not within the scope of our facilities, methods and experience . . . no desirable feature, in fact, that has not already been engineered into the Taylor Forge line.

That is why you find those added touches in WeldELLS like extra metal properly distributed where stresses are greatest . . . why WeldELLS have tangents . . . why dimensions are so extremely accurate . . . why they have features, listed opposite, that are combined in no other welding fittings . . . why, in the phrase that tells the story so well . . .

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS *have everything*

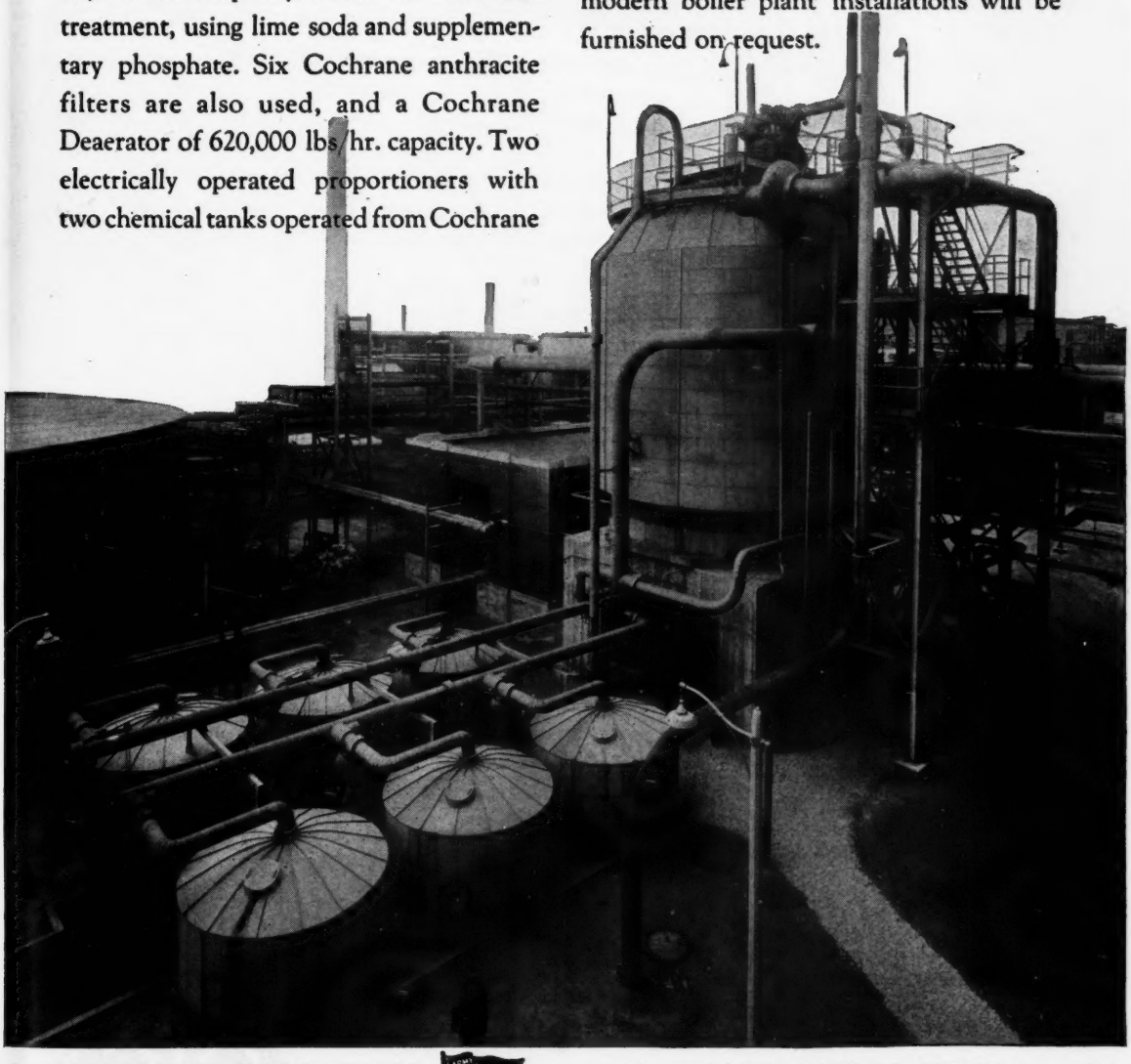
TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

ULTRA-MODERN WATER CONDITIONING

Using Latest Design Cochrane Equipment—

In this, one of the most carefully designed boiler plants constructed in recent years, a Cochrane Hot-Process Water Softener of 80,000 GPH capacity is used for the water treatment, using lime soda and supplementary phosphate. Six Cochrane anthracite filters are also used, and a Cochrane Deaerator of 620,000 lbs/hr. capacity. Two electrically operated proportioners with two chemical tanks operated from Cochrane controls on panel board are also part of this installation.

Complete details of this and many other modern boiler plant installations will be furnished on request.

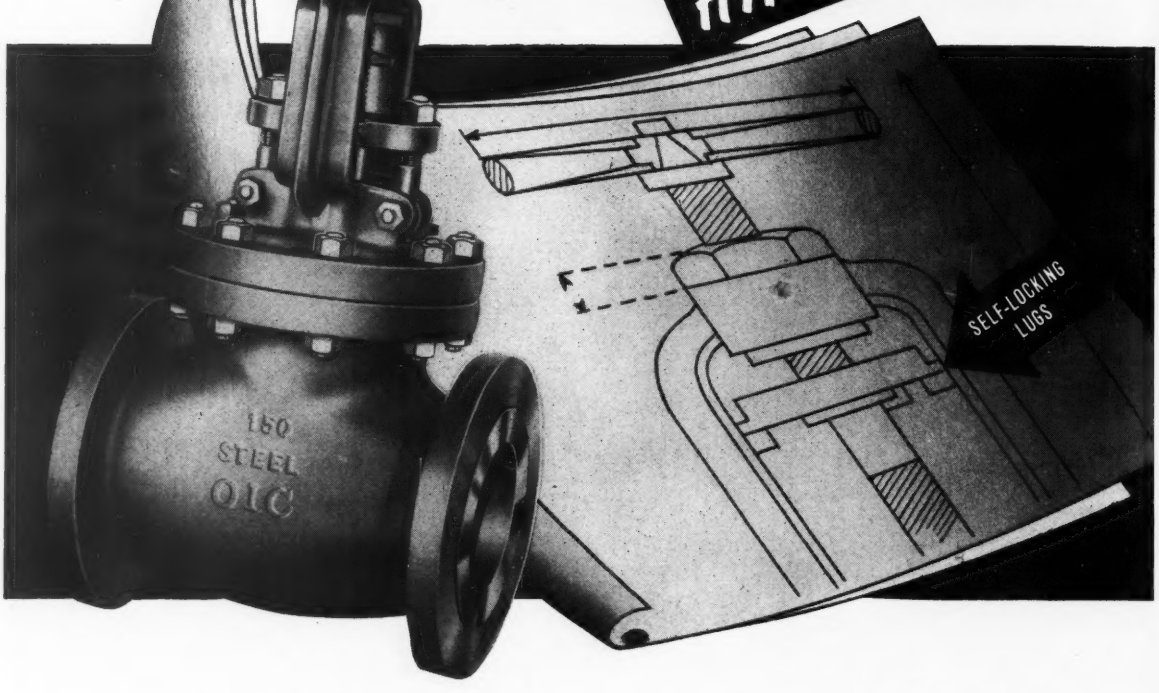


COCHRANE CORPORATION 3123 N. 17th ST., PHILADELPHIA 32, PA.

COCHRANE

SOFTENERS · DEAERATING SOFTENERS · DEAERATORS · METERS · STEAM SPECIALTIES

YES! THE OIC STEEL GLOBE VALVE HAS IT TOO!



Yes! The OIC Steel Globe Valve . . . like the Steel Gate Valve . . . *has:*—

(1) The "Helps Repack Itself" feature•

(2) Eye-bolts holding the packing••

(3) Full-threaded bonnet stud bolts•••

There is an OIC Distributor near you ready to demonstrate these and the many other exclusive features of OIC Steel Valves to you. Call him or write to us for complete details.

•*Tongued shelves on yoke arms and keyed follower hold packing unit up out of the way permitting faster, better packing under pressure. (Patent Pending.)*

••*Cannot be lost or misplaced like stud bolts.*

•••*Usually standard on higher pressure classes.*

ARMY E NAVY

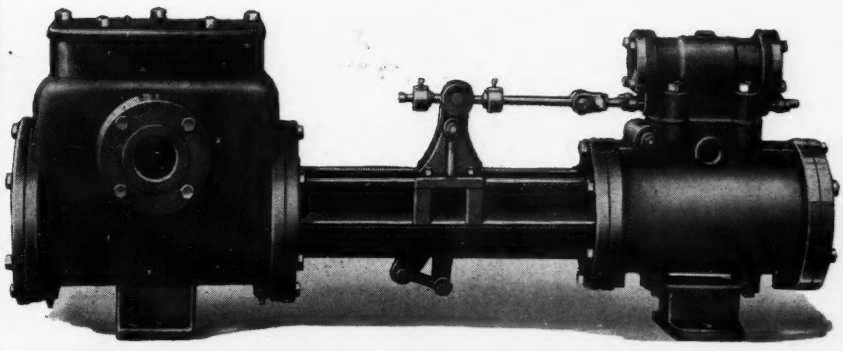
OIC

THE OHIO INJECTOR COMPANY

WADSWORTH, OHIO

Quality Leaders in Valve Manufacture Since 1883

Plan for the Future Right Now with



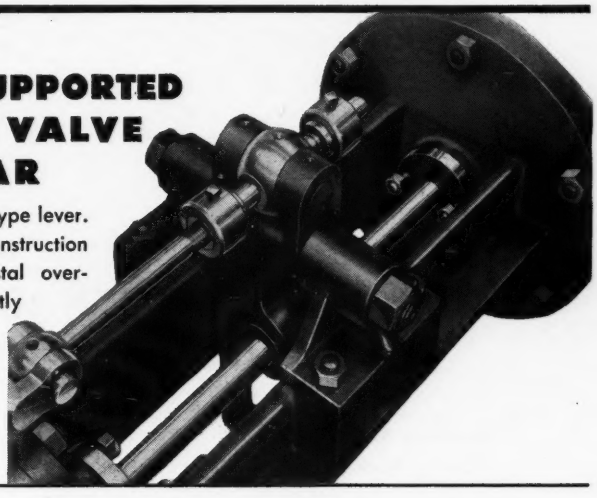
WARREN STEAM HEAT VACUUM PUMPS

It's not too early to check over your requirements for Steam Heat Vaccuum Pumps that you may need next Fall and Winter.
Look over these abbreviated "specs":

Look over these abbreviated "Specs"

RIGIDLY SUPPORTED ALL-STEEL VALVE GEAR

Note double fork type lever. Contrast this construction with single pedestal overhung type frequently used.



STEAM END

Steam cylinder and head, hard, close-grained, cast iron with thick cylinder walls suitable for reboring.

Steam valve mechanism, Warren patented "Eclipse" type. This valve mechanism insures positiveness of operation, full length of stroke and economy of steam consumption.

Valve gear, outside adjustable type, can be adjusted while pump is in operation.

Centerpiece, cast iron with reinforced side walls to prevent any distortion, thereby insuring permanent alignment to entire unit. Piston rod stuffing boxes cast integral.

LIQUID END

Liquid cylinder, head, and cap, hard, close grained, cast iron. Centrifugally cast bronze liner.

Liquid piston, cast bronze fibrous packed type with removable follower for packing adjustment or renewal.

Liquid valves, standard fitted pumps furnished with phosphor bronze, multi-disc type valves. Hard rubber disc type or stainless steel multi-disc type valves can be furnished.

Liquid valve seats, cast bronze, grid type, driven into valve decks on a smooth taper.

Piston rod, solid rolled bronze with tapered shanks and nuts for securing pistons.

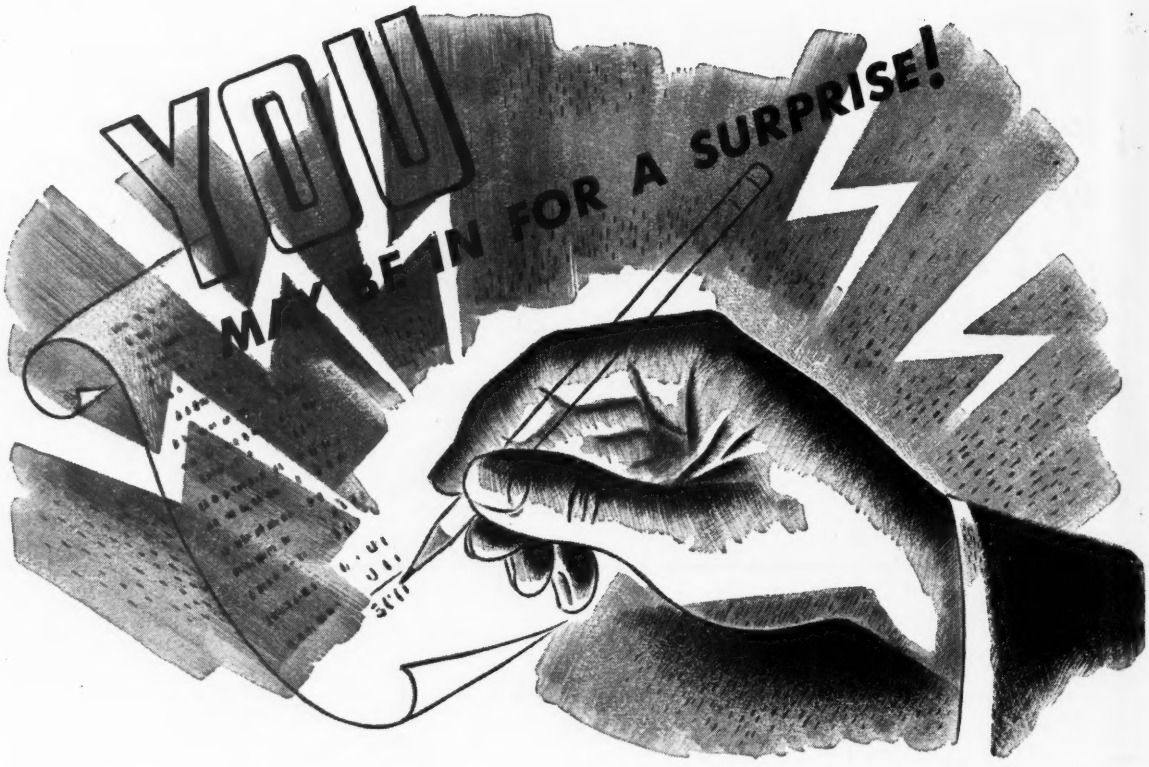
Send for

WRITE FOR BULLETIN 226-1 GIVING FULL SPECIFICATIONS, SIZES AND CAPACITIES

ARMY E NAVY

WARREN STEAM PUMP COMPANY INC.

Warren, Massachusetts



WHEN YOU CHECK UP ON YOUR PLANT'S PAY-ROLL SAVINGS PLAN FIGURES!

These days, things change with astonishing speed. The Pay-Roll Savings Plan set-up that appeared to be an outstanding job a short time ago, may be less than satisfactory today.

How about checking up on the situation in *your* plant? Checking up to see if everybody is playing his, or her, part to the full measure of his, or her, ability. Checking up to see if 'multiple-salary-families' are setting correspondingly multiple-savings records.

A number of other groups may need attention. For example, workers who have come in since your plant's last concerted bond effort. Or, those who have been advanced in position and pay, but who may not have advanced their bond buying accordingly. Or even those few who have never taken part in the plan at all. A little planned selling may step contributions up materially.

But your job isn't finished, even when you've jacked participation in your Pay-Roll Savings Plan up to the very top. You've still got a job before you—and a big one! It's the task of educating your workers to the necessity of not only buying bonds, but of *holding* them. Of teaching your people that a bond sold before full maturity is a bond robbed of its chance to return its full value to its owner—or to his country!

So won't you start *checking* . . . and *teaching* . . . today?

War Bonds To Have And To Hold!

LET'S ALL BACK THE ATTACK WITH WAR BONDS!

The Treasury Department acknowledges with appreciation the publication of this message by

Power Plant Engineering

This is an official U. S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council

There's something coming in its wake for you ____

NEW POWER FOR A NEW WORLD

All of us are beginning to hear lots of talk about the "lessons of war." Here's something specific on the subject. We are now producing engines for the fastest, hardest-hitting battle craft in all history...engines which emphasize the true meaning of efficiency, ruggedness and dependability. These engines will open up a new era of power for the industrial and engineering projects of peacetime America.

For civilian purposes of a hundred sorts Sterling will provide engines greatly improved over pre-war designs. They will utilize the best of the wartime developments in the science of metals. They will be the product of the toughest proving ground of all time—the fighting fronts of the world.

Let's start working together now on your engine needs. It is not too soon for you to put together a well organized power program. We are glad to make available the technical ability of highly qualified engineers and the invaluable experience of practical field men.

STERLING ENGINE COMPANY, Buffalo, N.Y.
Offices in New York, Washington, Chicago.

Oil through the busiest "highways" in the world—the pipe line—is hurried along by Sterling powered pumps.

Fishing fleets will need dependable, low cost power—the kind of power that Sterling engines can provide.

A new era in railroading will be marked by higher standards of power efficiency, aided by Sterling engines.

The harnessing of our natural resources will continue, with Sterling engines offering an immediate emergency power.

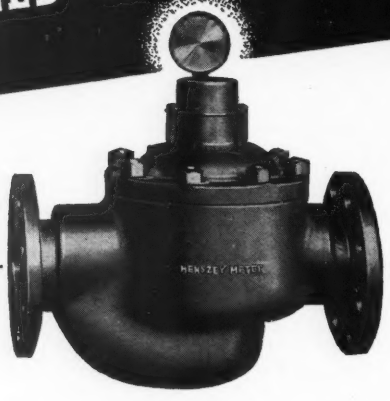
ETC. From air conditioning units to waterworks, wherever the need for power exists—there'll be a Sterling available.

STERLING ENGINES

GASOLINE DIESEL GAS

"KEEP BUYING WAR BONDS"

HENSZEY
FEED WATER METERS



There are hundreds of Henszey Meters serving in many different war industries. Their unique rugged construction without close clearances and with a minimum of working parts have enabled them to stand up under conditions that quickly break down ordinary meters. Henszey Meters are equally accurate at high or low flow—high or low pressures—on reciprocating or centrifugal pumps. Calibrations can be made to read in gallons, pounds or cubic feet at any specified temperature. They can be installed right in the line.

Check List

Use Henszey Meters for measuring

- ☐ BOILER FEED WATER
- ☐ HOT DIRTY BLOWDOWN
- ☐ CONDENSATE
- ☐ FREE RUNNING CHEMICALS
- ☐ OTHER "HARD TO MEASURE" LIQUIDS

Consider Henszey Meters for your liquid measuring problem! Write for full information.

HENSZEY CO. Dept. C5, Watertown, Wis.

HENSZEY

FEED WATER METERS

Continuous Blowdown • Distillation Systems • Heat Exchangers

Flow Indicators • Boiler Feed Regulators • Proportioning Valves

A2449

The Gas Turbine—Especially as Compared to the Steam Turbine

(*Continued from page* 101)

over long periods before the designer can use them with safety. Careful differentiation between applications, as to required length of life of apparatus, is necessary. The fact that a piece of equipment is operated at 1800 F for a life of a few hours does not mean temperatures of that order can be used for heavy duty applications.

Present developments of the gas turbine are limited to the use of relatively high grade fuel oils. This one factor is a serious handicap to the gas cycle. There is considerable evidence that oil is being used at a greater rate than new supplies are being found. So, in the post-war period, necessity may dictate a prime mover which can use coal as a fuel. The gas cycle is definitely limited in application until such time as the problems in connection with the burning of low grade oil and coal are successfully solved.

Present research efforts are being expended in developments for the National Defense. In the post-war era industry will have access to the developments in the gas turbine field and to developments in high temperature materials. These developments may considerably change present thinking. It is safe to predict that general applications of the gas cycle must wait until the post-war era.

It will be wise to watch the developments of the early installations before attempting to make wide-spread applications. At present, conclusions as to the ultimate possibilities of the gas cycle are little more than good guesses. The gas turbine art must advance beyond its present early development stages, before it can be judged with assurance. However, undoubtedly, it will find real usefulness in a large number of fields, possibly complementing rather than competing with the steam turbine. Just how and where the gas turbine will be applied, only time will tell.

Growing Use of Low Alloy Steels

As a result of the war, the use of alloy steels has increased and will continue after the war, B. B. Morton, metallurgical engineer, of the International Nickel Co., Inc., said in an address on recent trends and uses of alloy steels on March

. . . . . YOU MAY HAVE TO TRUST YOUR BOILER TO INEXPERIENCED HELP . . . . .

CASH STANDARD AUTOMATIC COMBUSTION CONTROL Systems

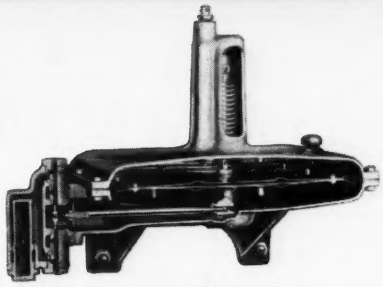
. . . remove all guess-work and manual error . . .

Keep your boiler room up to highest operating standards — save waste in fuel — get more steam — cut maintenance. Get all these results with the least in attendance requirements. Even though you must have inexperienced help you can still boost your boiler room performance.

CASH STANDARD Automatic Combustion Control gives you CORRECT FUEL FEED . . . you save coal, oil, or gas — PROPER AIR SUPPLY . . . you burn fuel economically — CONSTANT OVER-FIRE DRAFT . . . you prevent undue stack loss.

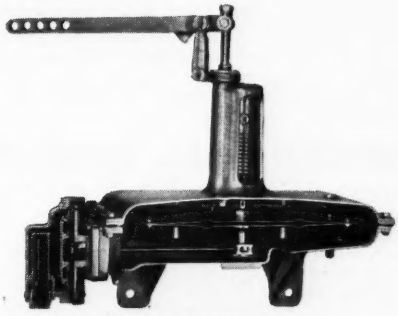
All of the units that comprise the complete system are available in numerous variations. Therefore, you can select combinations of these units to best serve your particular needs, whether you have a stoker, pulverizer, oil, or gas-firing equipment on your boilers.

To get details on the application of these units, whether you burn coal, oil, or gas, send for a copy of Bulletin No. 300.



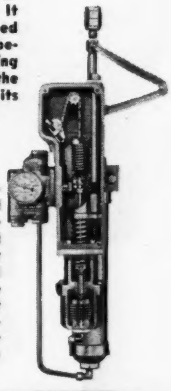
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD CONTROLS . . VALVES

SAVE COAL

—with FYR-FEEDER Multiple SPREADER Stokers

FYR-FEEDER stoker firing not only saves coal, but also permits you to burn any kind of wet or dry bituminous coal you have available locally—screenings or sweepings, any melting point of ash, free-burning or coking coals.

Burns Coal like Oil: FYR-FEEDER burns fines in suspension, burns larger pieces on grate. Coal is spread over entire fuel bed. Thin fuel bed—no clinkers. Fires can be cleaned in two minutes! Suitable for large or small boilers. Very little maintenance cost. In many cases FYR-FEEDER stokers have made it unnecessary to add another boiler to handle increased loads.

FYR-FEEDER is our own original design. FYR-FEEDER is not a copy of any other stoker but our own invention developed by us, and our engineering experience with spreader stoker design, installation and operation began in the last century.

WET COAL IS NO HANDICAP

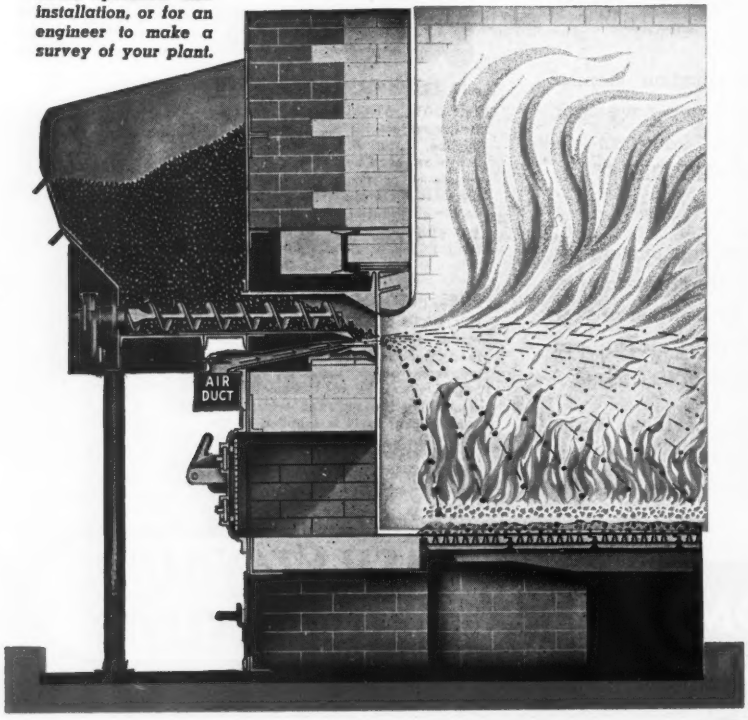
Coal men like the FYR-FEEDER because FYR-FEEDER users do not insist upon the delivery of "DRY" coal since FYR-FEEDER handles "WET" coal satisfactorily. Regardless of "rain and snow watered" coal, FYR-FEEDER stokers produce plenty of steam from "WET" coal. FYR-FEEDER was designed to use "WET" coal or dry coal.

AMERICAN COAL BURNER COMPANY

—Engineers—

WRITE FOR CATALOG describing features, operation and installation, or for an engineer to make a survey of your plant.

22-18 E. Erie St. Chicago 11, Ill.



29, at a meeting of the Metropolitan Section of the ASME.

The address dealt with current trend towards securing maximum benefits from the use of alloying elements in modern alloy steels. The reasons for putting various alloying elements into steels were discussed from the standpoint of improvement and modification of mechanical and other physical properties and increased corrosion resistance. Low alloy and stainless steels were also touched upon. The speaker foresees a greater demand for lightweight equipment, especially in the transportation field.

He stressed the importance of the "strength to weight" ratio, rather than lightness alone in constructional materials. He cited the 18 per cent chrome and 8 per cent nickel, stainless steels as outstanding examples of an alloy "developing possibly the highest ratio of strength to weight of any commercial alloys available." He described other features of this alloy including its pleasing color, ability to reflect heat, and other properties.

Anthracite Fines Being Investigated

INVESTIGATIONS and experiments are being made at the request of the Office of Solid Fuels Administration for War to explore the possibilities of using more anthracite fines—No. 3 size and smaller—to mix with bituminous coal in briquettes, to replace low-volatile coal in by-product coke ovens, and in gas producers which normally use larger sizes of anthracite.

A program to effect a material reduction in the national stockpile of anthracite fines was begun recently by the Solid Fuels Administration after the Bureau of Mines conducted tests showing that mixtures of anthracite "barley" and bituminous slack coal will burn in underfeed stoker equipment with about the same efficiency as straight bituminous coal.

Demands for this type of fuel in army camps and private plants are increasing, but additional consumption is necessary under the war program. Anthracite fines are described as a slow-moving fuel, and the piling up of supplies delays the production of larger sizes of anthracite needed for domestic heating purposes.

Outlining the investigations that the Bureau will undertake, Dr. R. R. Sayers, Director of the Bureau, has advised that engineers will consider whether an increase in

STILL SETTING THE PACE!

Bred in ole Kentucky and the favorite round-the-world

Vogt

DROP FORGED STEEL VALVES

continue to give thoroughbred performance in pipe lines where the "heat is on" in high-octane gasoline, synthetic rubber, powder, chemical and hydraulic plants, as well as naval and marine service.

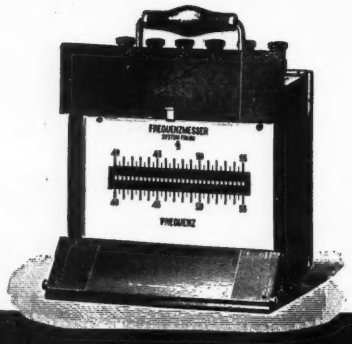
Write for catalog F8, the blue book of drop forged steel Valves, Fittings and Flanges.

HENRY VOGT MACHINE CO., Inc., LOUISVILLE 10, KENTUCKY

Branch Offices: New York - Chicago - Cleveland - Philadelphia - Dallas

. . . IN 1910

the wood engraving at the right appeared in our first bulletin on Frahm Resonance Frequency Meters.



AND TODAY . . .

the Frahm instruments shown below are but typical of the thousands we build each year.

In the 34 years that have passed since Mr. James G. Biddle introduced Resonant Reed Frequency Meters to American industry, the basic principle of these instruments has not changed. Countless refinements and improvements have been made since that date, and the range of application is being constantly broadened. Frahm Resonant Reed instruments are still as unique and as outstanding as they were in 1910, and through Biddle experience, research and development, continue to lead the field.

Write today for Bulletin 1695-PE

James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

the quantity of anthracite used in the briquetting industry is feasible, and whether idle and new-type equipment can be put into operation. A suggestion that some building brick-making equipment, not in use at certain seasons, can be employed in pressing fuel briquettes, also will be investigated.

Experiments will be made with gas producers, Dr. Sayers added, to ascertain whether the installation of a mechanical agitator in the fuel bed will permit the burning of smaller sizes of anthracite than now being used, and at the same time maintain the same capacity.

SPAA to Meet in Detroit

ARRANGEMENTS for the June meeting of the Smoke Prevention Association of America to be held in Detroit, Mich., June 6-7-8-9, are progressing rapidly under direction of the chairman of the Arrangements Committee, Frank J. Gibbons, Acting Chief Smoke Inspector, Detroit. Building Commissioner Joseph Wolfe is the co-chairman of this committee. A. F. Arbury of Detroit is promoting interest among local industries and has arranged for the active participation of the coal group.

The speaking program includes: Thomas Cheasley, Washington, D. C., "The Program of the National Fuel Efficiency Section of the U. S. Bureau of Mines"; Julian Tobey, New York, N. Y., "The Post-War Influence on Smoke Abatement of the Bituminous Coal Research Program"; P. T. Tolin, Jersey City, N. J., "Locomotive Smoke Abatement in Terminals."

A round-table discussion of railroad smoke abatement and locomotive fuel problems will be included in the program, at which Eugene D. Benton, Fuel Engineer, Louisville, Ky., will act as moderator.

Headquarters for the meeting will be Hotel Statler.

The MHO-Carrier Relaying Scheme

DUE TO THE WARTIME problems of increased loads and shortage of materials it is often necessary to put heavy loads on existing transmission lines rather than build new ones. A simplified carrier scheme for long or heavily loaded transmission lines is described in an AIEE technical paper, "The MHO-Carrier Relaying Scheme," by R. E. Cordray and A. R. van C. Warrington of General Electric's Relay Engineering Division.

When transmission lines are heavily loaded it becomes difficult

Scovill Tube News

Vol. 2 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn No. 4

Corrosion of Condenser Tubes ...Causes and Cures

Scovill offers two folders on obtaining longer tube life

Among the common causes of corrosion in condenser and heat exchanger tube metal are the following, each of which is discussed in two folders which have been prepared by Scovill Manufacturing Company engineers as one of three Scovill services to power plant operators:

Film Formation

The ability of copper and its alloys to form protective films on their surfaces explains their inherently excellent corrosion resistant properties. In order to be protective, the film must be adherent, continuous and relatively insoluble. The formation of soluble salts at the metal surface will lead to continued corrosion. Likewise, coatings which are porous, loosely adherent, friable or easily broken, or discontinuous, offer little protection to the metal.

Accelerated Uniform Corrosion

Tubes in service under conditions which result in corrosion at the tube surface with the formation of soluble salts only, will undergo a uniform thinning of the tube wall. This is often experienced in acid solutions, particularly with oxidizing acids or acid solutions containing oxygen or an oxidizing agent. Solutions which have a definite solvent action on the products of corrosion of copper alloys, such as solutions containing ammonium hydroxide or cyanides, would behave similarly.

Impingement Attack, End Corrosion, etc.

Rapid and repeated destruction of protective surface films usually occurs at or near the inlet end of the tubes and is variously described as "impingement attack, end corrosion, etc." There are usually certain localized areas in a unit or sections of a unit where failures from this cause predominate. The destruction of protective films at such localized areas is due to a relatively high velocity of the circulating medium, together with a turbulent condition and the action of entrained or separated air.

Concentration Cell Action

Many cases of localized corrosion and failure of condenser and heat exchanger tubes are due to local differences in solution concentration or composition which may develop at the metal surface. A break in an otherwise satisfactory protective film may initiate such action. Cracks, crevices or other small openings at baffle or support plates where liquids may seep and become trapped are always a potential source of trouble in this respect.

Deposit Attack

Corrosion of the "deposit attack" type (a special form of "concentration cell" action) is directly due to the settling out or lodgment on the tube wall of sand, mud, coke, stones, wood, shells, flakes of iron scale, etc. Part of the metal surface becomes shielded or protected by the deposit and usually becomes anodic to adjacent metal areas; intense pitting at such shielded areas is likely to occur. If the deposit is of sufficient size to interfere seriously with the flow of the circulating medium, turbulence, air separation and erosion-corrosion of the down-stream side of the tube may take place.

Plug- and Layer-Type Dezincification

Brasses containing less than 85% of copper may undergo corrosion which results finally in the gradual replacement of the brass by a spongy, porous copper deposit. This deposit may occur locally, developing into "plugs" of copper, or it may occur uniformly over the tube surface — in which case it is designated as "layer-type" dezincification. Conditions which favor dezincification of condenser tubes are:

(1) Contact with waters slightly acid in character and of a low degree of aeration.
(2) Relatively low velocity of water over the tube surfaces, or stagnant water in tubes.
(3) Relatively high temperatures.
(4) Certain types of permeable scales on the metal surface.

Galvanic Action

The indiscriminate use of dissimilar metals and alloys in any service, when they make good contact and are also subjected to a conducting medium, may lead to the early failure of one member of the couple. In the design of equipment which is to be used for handling liquids, moist gases or vapors, therefore, the possibility of galvanic corrosion should be given careful thought.

Such are the common causes of trouble. The cures for these troubles may be determined with the aid of Scovill's two other services:

Service in Men, which gives you the benefit, through consultation, of the many years' experience represented by Scovill engineers.

Service in Metals, which gives you complete laboratory and production facilities (as national needs permit) in the working-out of a solution to your problem.

For a further demonstration of *Service in Manuals*, of which the foregoing information is a sample, write us for Scovill's free "Condenser Tube Booklet", containing diagrams, formulae, description of alloys. Address Scovill Manufacturing Company, 17 Mill St., Waterbury, Conn.

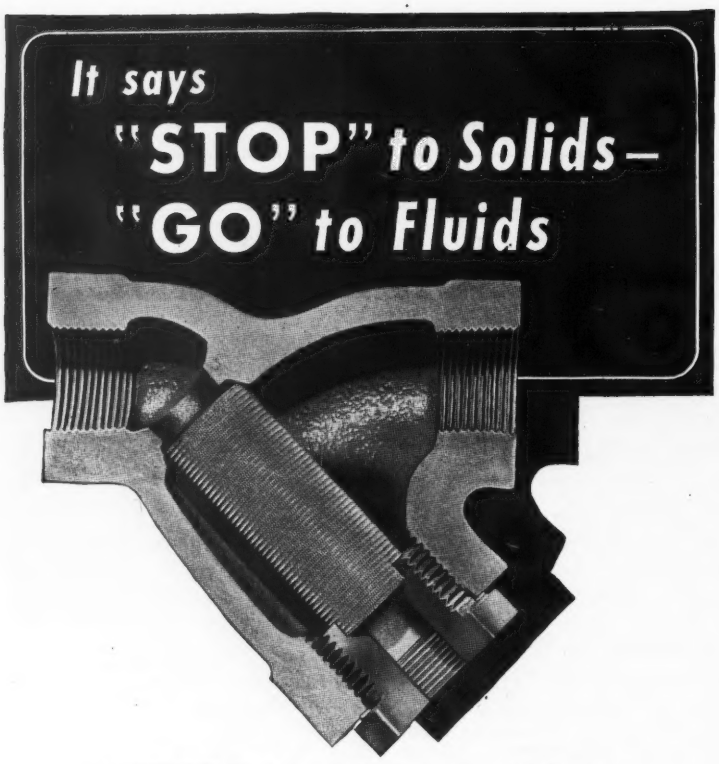
THIS IS NUMBER TEN in a Series of Scovill Advertisements to help you get longer life from condenser and heat exchanger tubes.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

SCOVILL CONDENSER TUBES

ONE PRODUCT... THREE SERVICES

Service in Manuals... Service in Metals... Service in Men

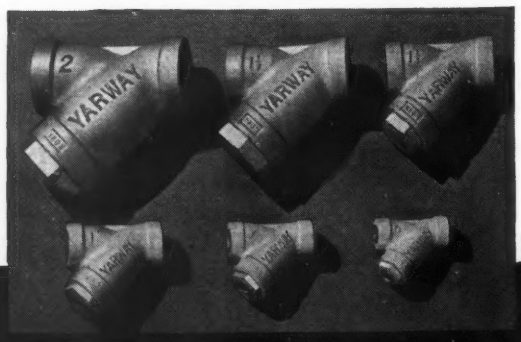


A BETTER Strainer to "police your pipelines"

- **FIRST**—*The Screen*, a high-grade woven Monel wire basket that catches solids—lets condensate, oil or other fluids flow freely.
- **SECOND**—*Finish*: Cadmium plated inside and out for protection against corrosion.
- **THIRD**—*Easily Cleaned*. Blow-off bushing made for easy removal. Bushing and Screen come out together. Screen automatically aligns on reassembly.
- **THOUSANDS IN SERVICE**—Sold by over 100 Mill Supply Houses.

6 sizes from ½" to 2" for pressures up to 600 lb. Reasonably priced. See your supply house or write for Bulletin S-200.

YARNALL-WARING COMPANY
114 Mermaid Ave. PHILADELPHIA 18, PA.



YARWAY STRAINERS

to retain relaying selectivity because the currents and voltages which the relays measure are not sufficiently different to distinguish between faults and power swings, except by adding auxiliary relays which check the rate of change of impedance. These auxiliary relays add complexity and cannot distinguish between power swings during which it is not desired to trip and an out-of-step condition for which it may be desired to trip.

The scheme discussed by Messrs. Cordray and van C. Warrington inherently distinguishes between these swings and out-of-step conditions and also is much simpler than its predecessors. In reality an extension of the directional-distance relay, it uses phase-angle as well as impedance magnitude as a basis for distinction between load and fault conditions.

This new carrier scheme uses the "MHO" unit, which measures admittance in MHO's at about the phase angle of the protected line. This is to provide a very high pick-up on loads and power swings when set to operate on a fault at the end of the section. In this way, the relays keep the transmission line in service as long as it can transmit power and remove it only when the systems swing apart so far that power cannot be transmitted.

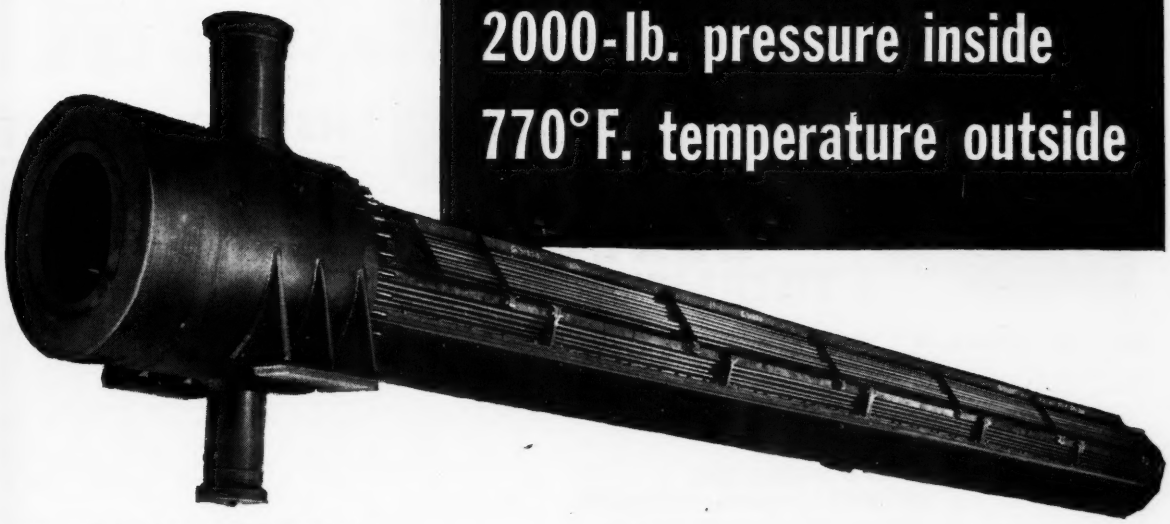
The paper goes on to compare impedance relays with reactance relays and in this connection states that an impedance element was selected for starting carrier because it will operate on power swings as well as faults. It has the advantage of being available, on medium length lines, for preventing tripping or reclosure on out-of-step conditions. It can also be used for controlling a timing unit for back-up purposes if the stepped distance type back-up is desired.

The second or tripping element in the relay scheme is the MHO unit. This unit which has been known for many years as the starting unit of the reactance-type distance relay, has double-wound current coils which give the same reach on phase-to-phase as on three-phase faults.

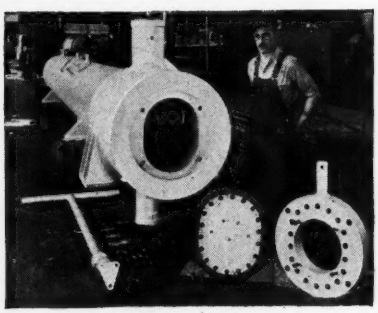
Ground relaying has been considerably simplified by a return to the original idea of back-to-back directional relays, which is permissible for ground relays because there is no complication of power swing currents entering at right angles to the fault currents.

The conclusions of the paper are that the new scheme has a direct approach to the problem of relay-

2000-lb. pressure inside 770°F. temperature outside



SHELL REMOVED, showing seamless Monel tubing ¾" OD by .065" wall, calculated to carry 11,500 lbs. p.s.i. unit stress in the tube wall metal. Corrugated joint gaskets are made from Monel sheet.



ASSEMBLED HEATER. Shell carries steam at 770°F. and 650 lbs. pressure. Feed water, while passing through tubes at 2000 lbs. pressure p.s.i. is heated to 475°F.

Water pressure 2000-lb. p.s.i. *inside* . . . steam at 770° F. *outside*.

That's the extremely tough combination met by Monel seamless tubing in boiler feed water heaters, built by the Griscom-Russell Co., New York, N. Y., for the Oswego Station of the Central New York Power Corporation.

These heaters have U-tubes to eliminate necessity for floating head construction as the U-bends take care of differential expansion.

Four heaters with Monel tubing were placed in service at this station during 1940–41.

They have not been idle a moment . . . nor cost a penny for repairs!

Monel performs faultlessly because of its unique combination of properties. It retains strength and toughness at high temperatures. It resists the formation of corrosion film which would decrease the efficiency of heat transfer properties.

Monel is long on life . . . short on upkeep cost . . . and a ready answer to most metal problems in power plant equipment.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

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"27 Times the Power Output"

This report, now being printed, gives the latest information on Monel tubed high pressure heaters, with data on working stresses for non-ferrous materials allowed by new A.S.M.E. Boiler Code for unfired pressure vessels.

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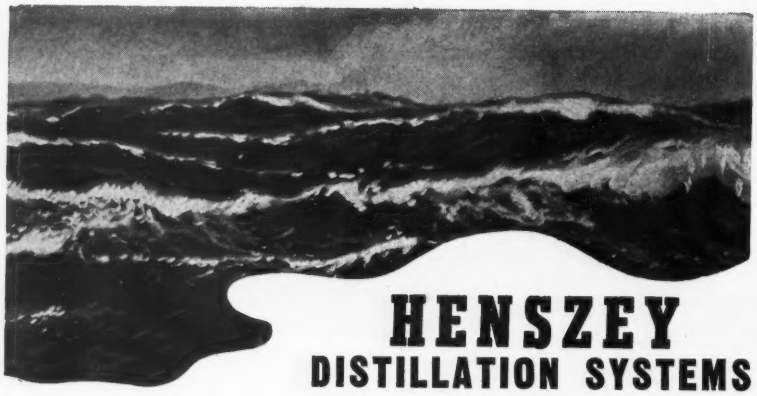
P.P.E. 5—44



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deliver PURE WATER *at exceedingly* LOW COST!

And that's important if you need an abundant supply of absolutely pure water for:

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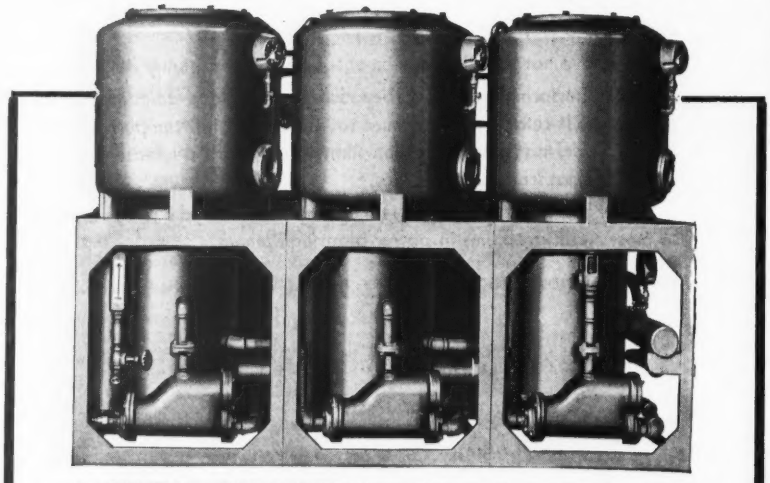
- HUMAN CONSUMPTION

If it is your responsibility to provide ample, low cost supplies of absolutely pure water—investigate Henszey Distillation Systems now.

HENSZEY CO. Dept. C5 Watertown, Wis.



6 EFFECT EFFICIENCY with only 3 EFFECTS

A remarkable achievement of design and performance!

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DISTILLATION SYSTEMS

Continuous Blowdown • Heat Exchangers • Boiler Feed Regulators
Feed Water Meters • Flow Indicators • Proportioning Valves

A2450

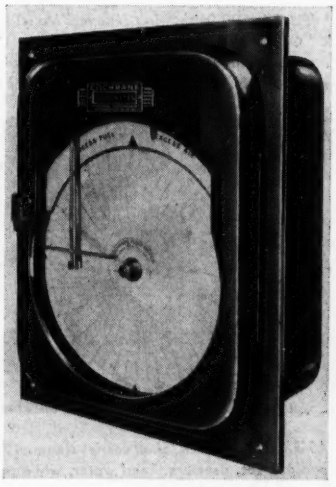
ing heavily loaded transmission lines and has the virtue of considerable simplification over previous schemes. It is applicable to all lines which would be normally considered long enough to justify the cost of carrier relaying.

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. WRITE TO POWER PLANT ENGINEERING

Boiler Meter

COCHRANE CORP. of Philadelphia has announced a new boiler meter of the steam-flow, air-flow type, known as the Cochrane boiler ratio meter. With this meter the operator can establish the relation of air supply to fuel supply (measured by steam generated) most favorable to his particular operation by means of an easily adjustable cam in the air flow mechanism.



Quick and easy reading is provided by a red indicating pointer operating across a white 10 in. scale, making it unnecessary to examine closely the position of the pens to determine whether the air is excessive or insufficient, as the movement of the pointer is three times as great as the differences between the pens.

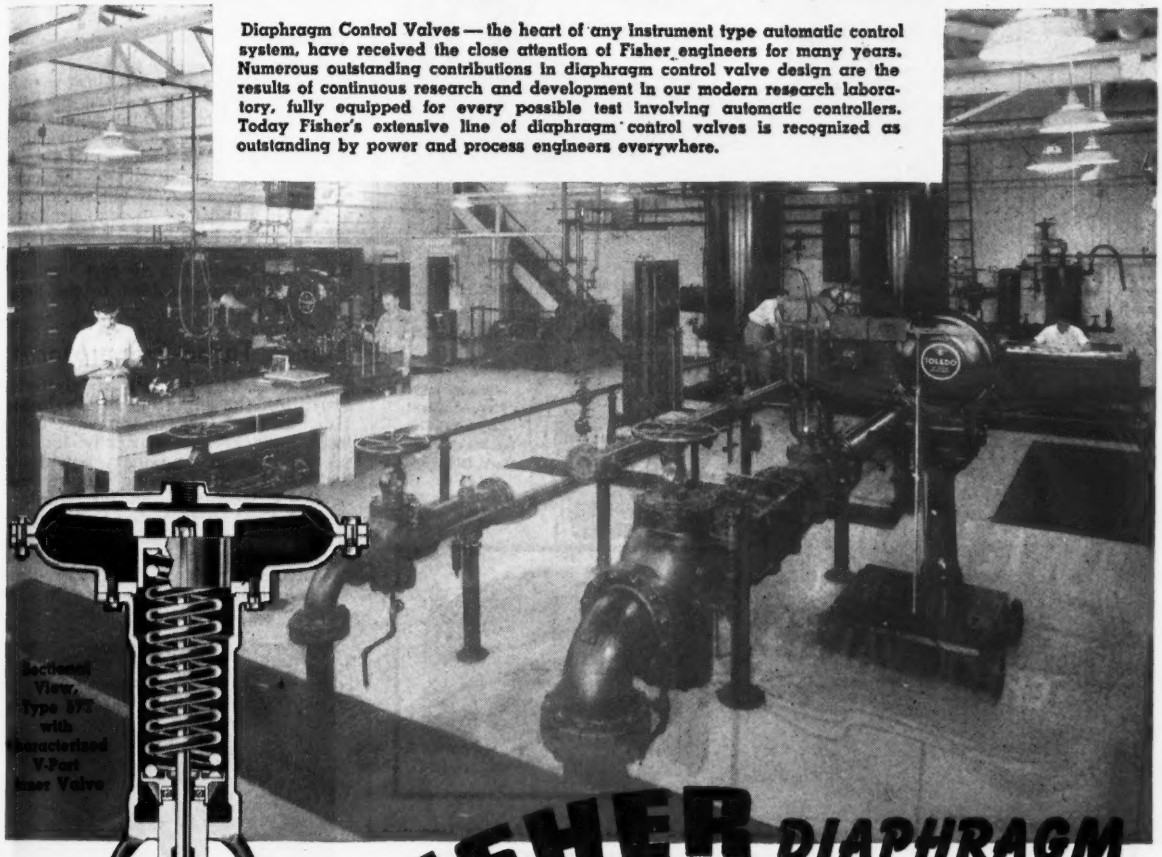
The steam flow mechanism is that of the standard Cochrane friction-free electric flow meter, operating on the null balance principle, assuring highest accuracy. The air flow mechanism is based on the highly responsive Hays slack diaphragm, equipped with an electric motor follow-up for ample power.

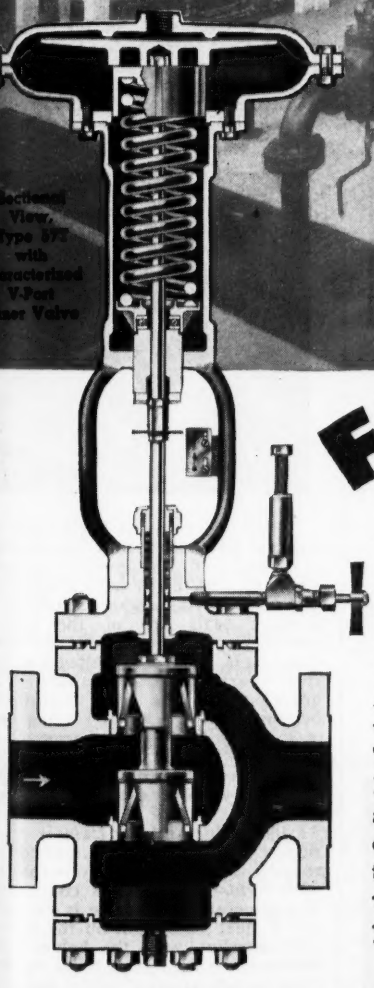
Combined Socket Wrenches

THE NEW Tesco Multi-Socket Wrench with the same approximate dimensions as a single socket wrench and with very little additional weight, automatically accommodates No. 10 standard, No. 12 standard, ¼ in. standard and light, and 5/16 in. light hexagon nuts. Merely pressing the wrench over any of the three sizes of nuts automatically selects the proper nested hexagonal tube suited

★ THE HEART OF ANY INSTRUMENT TYPE AUTOMATIC CONTROL SYSTEM ★ ★ ★ ★

Diaphragm Control Valves — the heart of any instrument type automatic control system, have received the close attention of Fisher engineers for many years. Numerous outstanding contributions in diaphragm control valve design are the results of continuous research and development in our modern research laboratory, fully equipped for every possible test involving automatic controllers. Today Fisher's extensive line of diaphragm control valves is recognized as outstanding by power and process engineers everywhere.



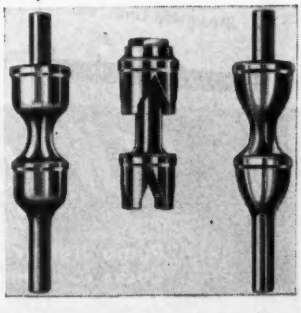


Sectional View, Type 572 with Characterized V-Port Inner Valve

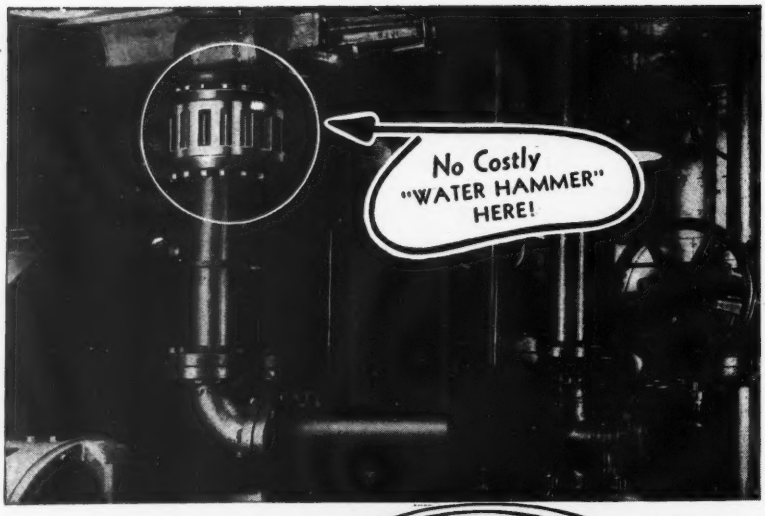
FISHER DIAPHRAGM CONTROL VALVES

are designed to control the flow of all kinds of fluids at all temperatures and pressures. Operated through the action of a primary pilot valve supplying auxiliary pressure to the diaphragm, they provide full throttling control in exact accordance with the dictates of the pilot valve.

Available with a wide selection of inner valve designs — Characterized V-Port, Throttle or Ratio Plug, Single Port Needle Point, and many others. Each valve structure provides a specific type of flow curve. Fisher Engineers are always ready to recommend the correct type of inner valve and body design to exactly meet your requirements.



FISHER GOVERNOR COMPANY, 1020 FISHER BLDG. MARSHALLTOWN, IOWA



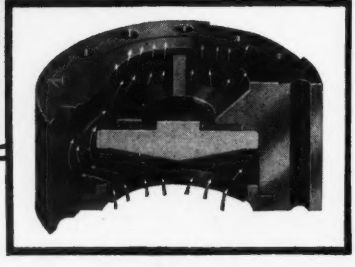
A 10"-300 lb. Williams-Hager Flanged Silent Check Valve in the Merchandise Mart, Chicago.

Dependable Protection with

WILLIAMS-HAGER

FLANGED SILENT

CHECK VALVES



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Successfully used to prevent Pump Failure, Line Breakage due to "Water Hammer" on Water, Steam, Hydraulic, Chemical or Oil Lines!

Heavy duty service records upwards of 17 years without removal from lines . . . Williams-Hager Flanged Silent Check Valves are built to meet the exacting requirements of any end use. No webs to restrict or hamper the flow of liquids . . . the free-floating valve will operate normally and efficiently in *any* position.

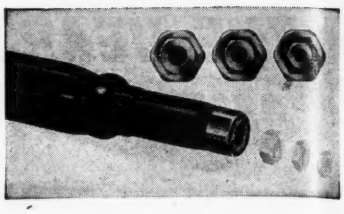
Dependably constructed in sizes from 1" to 20" inclusive, from iron, semi-steel, bronze, cast steel, stainless steel or monel . . . pressure resistant to 6,000 pounds.

Write today for interesting folder on "Water Hammer—Cause, Effect and Control in Piping Systems."

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

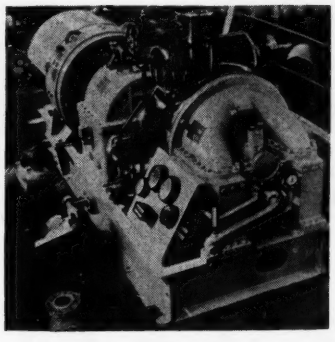
3000 PENNSYLVANIA AVENUE · PITTSBURGH (12), PA.



to that particular nut. This wrench, manufactured by The Eastern Specialty Co., 3617 N. 8th St., Philadelphia, Pa., is specifically designed for heavy duty service, any stress incident to turning a nut being transferred to the outer hardened-steel casing. It is also designed to provide a clearance through the barrel for studs up to 5½ in. length. Both handle and barrel have moulded insulations. The handle is a die cast aluminum member pressure-moulded to the hexagon steel barrel.

Hendy Turbo-Generator

IN DEVELOPING the new Hendy turbo-generator, the engineers of the Joshua Hendy Iron Works, Sunnyvale, Calif., have built a unit especially for war service. The new auxiliary power unit had to meet the exacting requirements of the U S. Navy and the Maritime Commission Standardized Specifications. Its basic design covers a wide range of output, starting at 250 kw. The modern trend toward simplification has been followed throughout in the design.

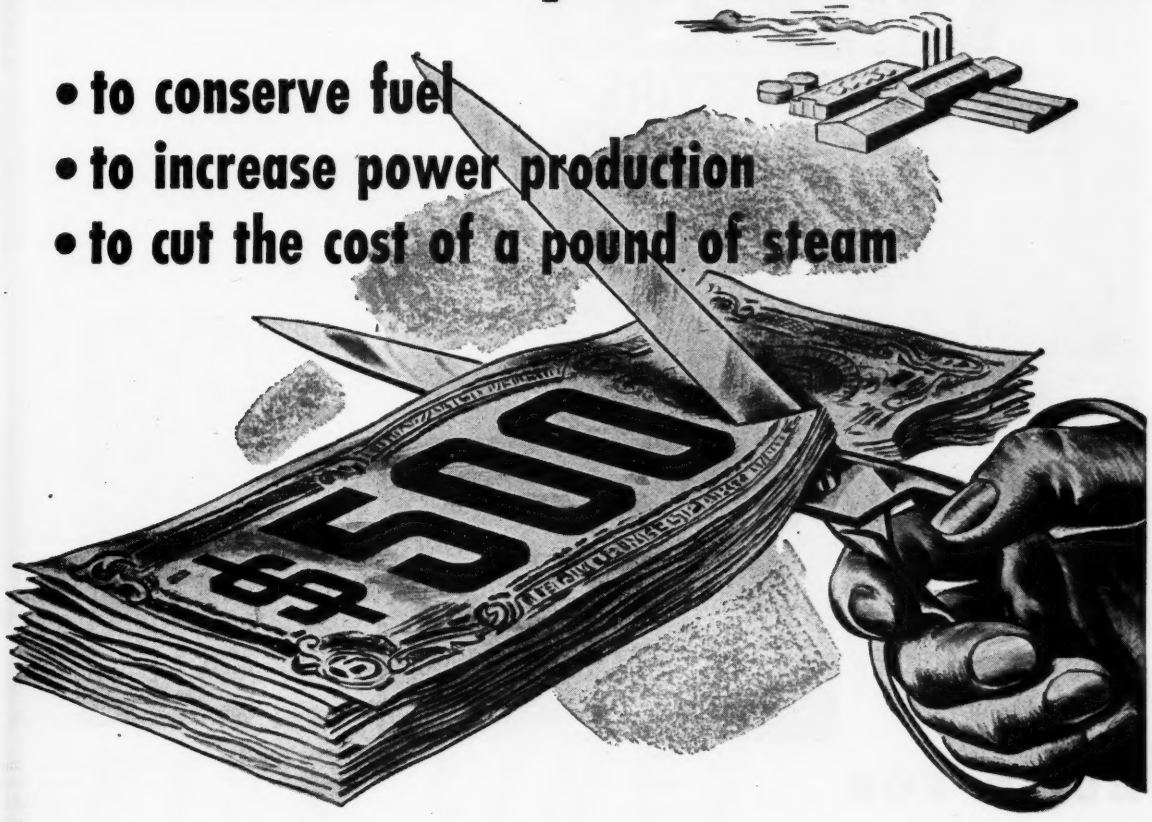


The turbine has an economical water rate per kwhr, thus insuring low operating cost. The spindle is of large-diameter with disks having large hub sections, assuring greater strength. Interstage seals are of the stop-cut labyrinth type. The steel Rateau nozzle disks have welded-in, rolled stainless-steel nozzle blades and spacers. The governing system uses anti-friction bearings and is without stuffing boxes or soft packings, assuring accuracy and simplified control. Smoothness and compactness of design have been achieved without sacrifice of accessibility.

The reduction-gear case is of fabricated steel, smoothly finished with rounded corners. Rigidity is combined with light weight in its construction. The generator field yoke is formed of rolled steel plate, split on the horizontal centerline with the halves bolted together. It is of shockproof construction, which assures safety under adverse conditions. The shaft bearing is of the sleeve type, mounted in a self-alining spherical seat, insuring alinement.

MODERNIZE your Boiler Plant

- to conserve fuel
- to increase power production
- to cut the cost of a pound of steam



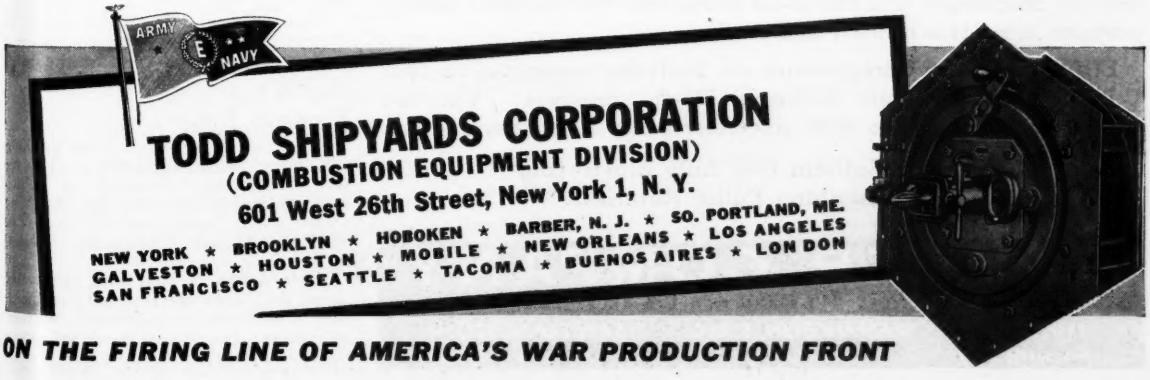
GREAT strides have been made in the efficiency of combustion equipment in the last decade, and TODD research engineers have led the field.

Fuel savings as high as 10%—plus even larger increases in heat and power production—are not unusual when modern TODD burners replace less efficient types! And this means, of course, a substantial reduction in the *cost* of producing steam.

Right now, when fuel waste is a national problem and power production is at a premium, it is doubly important that you get a survey of your boiler plant, and install modern equipment at the first opportunity. TODD engineers will be glad to make an impartial study of your entire heat and power set-up, without obligation.

And remember, the manufacturer, whose steam costs are reduced to a minimum *now,* will be in a better economic position when normal competition returns. For steam is a "raw material" in the production of practically every product.

From every point of view, conditions now are favorable for boiler plant modernization. Get detailed specifications of needed improvements immediately.



TODD SHIPYARDS CORPORATION
(COMBUSTION EQUIPMENT DIVISION)
601 West 26th Street, New York 1, N. Y.

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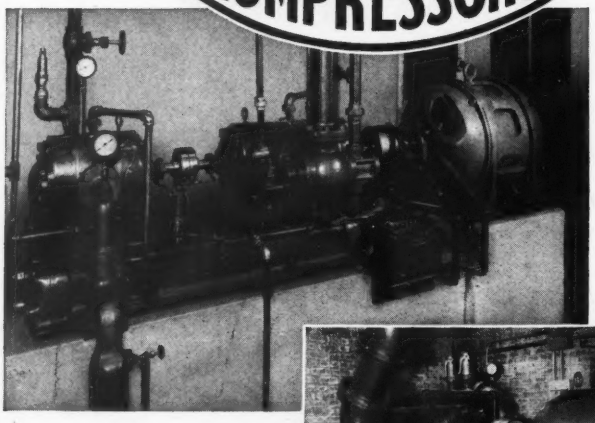
SAN FRANCISCO ★ SEATTLE ★ TACOMA ★ BUENOS AIRES ★ LONDON

ON THE FIRING LINE OF AMERICA'S WAR PRODUCTION FRONT

ROTARY
FULLER
COMPRESSORS



BUILT FOR
TROUBLE-FREE OPERATION

Rush! Rush! Rush! More speed all along the line. That's the cry today. But speed is not enough . . . equipment must be able to stand up under the most severe operating conditions . . . service must not be interrupted. Breakdowns—delays—time out—all mean loss of vital production and money out of pocket.

With this thought uppermost, only the best of materials and workmanship go into the makeup of Fuller Rotaries. They're built for trouble-free operation and performance records prove them to be just that. When, after long, gruelling operating periods, inspection and check-up is desired, the machine design permits doing this quickly and easily.

FULLER Rotary Compressors are built for capacities to 1800 C.F.M. actual free-air delivery, 125-lb. pressure. Vacuum pumps for vacuums to 29.90-in. (referred to 30-in. barometer).

Write for Bulletin C-5, fully illustrating and describing Fuller Rotaries.

C-60

FULLER COMPANY
CATASAUQUA—PENNSYLVANIA
CHICAGO, 3 Marquette Bldg. WASHINGTON, 5, D.C. Colorado Bldg. SAN FRANCISCO, 4 Chancery Bldg.

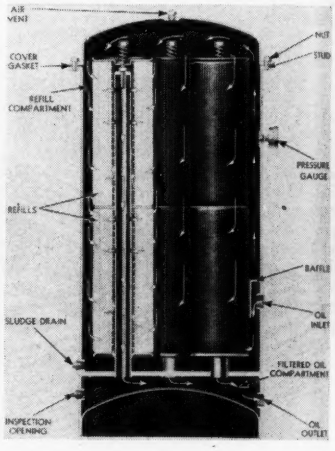
Sealing Compound

JOHNS-MANVILLE has announced the addition of Uniseal, an all-purpose sealing compound, to its line of plastic sealing compounds.

Uniseal, under laboratory tests and field conditions, has proved especially effective as a seal against weather and water absorption, and it is reported to be highly resistant to vapors, fumes and to heat-hardening.

Fuel Oil Clarifier

BRIGGS CLARIFIER CO., Washington 7, D. C., announces an improved standard line of round tank fuel oil filters for Diesel engines. New models have been added to broaden the application of Briggs fuel oil clarifiers so that flow capacities range up to 500 gph.



Maximum working pressures and hydrostatic test pressures have been established to meet specific demands of the application. For small high speed Diesel engines where pressures sometimes run well above 50 psi, the clarifier is designed for a maximum working pressure of 100 psi and is hydrostatically tested at 150 psi. For large, heavy-duty Diesels where pressure is usually between 15 and 25 lb, the clarifier is designed for a maximum working pressure of 40 psi and hydrostatically tested at 60 psi. Pressure drop across the refills ranges from 0 to 5 psi on all models.

Provision is made for registering pressure differential across the refill cartridges by installing one gage in the upper compartment of the tank and another in the lower compartment. A glance tells the operator the exact pressure differential and when to change refills.

Improvements have been made in the refill holding assembly to assure a perfect seal at both ends of the refill cartridge.

Process Timer

THE TAYLOR process timing mechanism for Fulscope temperature or pressure controllers, production of which was suspended soon after the beginning of the war, is again available from The Taylor Instrument Companies, Rochester, N. Y.

This device is built into either the single duty Fulscope recording temperature or pressure controller and functions as follows: The process is started manually by adjusting the instrument for the

THEY'RE 3-WAY COST-CUTTERS

FOR DOUBLE EXTRA HEAVY

EXTRA HEAVY

STANDARD

PIPE LINES

Watson-Stillman Forged Steel Socket Welding Fittings offer two economical advantages in lower material cost and lower welding cost. Their efficiency and long-wearing qualities are also important factors in keeping down maintenance and operating costs.

W-S Socket Welding Fittings are easy to install — just slip over pipe and weld. No special fixtures are needed to hold or line up joint — the deep socket supports the pipe. Tack welding is unnecessary. Fittings have same inside diameter as pipe — assuring smooth unrestricted flow.

Bulletin A-3 gives complete specifications and engineering data for all Watson-Stillman fittings, including a complete line of screw end forged steel fittings. The Watson-Stillman Co., Roselle, N. J.

WATSON-STILLMAN

Distributor Products Division

DESIGNERS AND MANUFACTURERS OF FORGED STEEL FITTINGS, VALVES, AND HYDRAULIC EQUIPMENT

For Old Darts . . .
to be used again!

Any time spent in locating old Dart Unions around your plant buildings and yards is *well worth* while . . . for, Darts are made to be used over and over again, giving tight joint, economical performance each time. (And when you re-use your Darts, you are conserving the Nation's metal supply.)

There are good and sufficient reasons why Dart Unions can be used so many times with such satisfactory results. And these reasons are worth remembering. *Darts have matched bronze seats, ground to accurate "true-ball" surfaces* . . . Darts bodies and nuts are made of air refined malleable iron that resists pipe strains, rough handling, rust.

Even if you have already made several searches for your old Darts, authorize *another* one. And see your supplier if you need *new* ones.

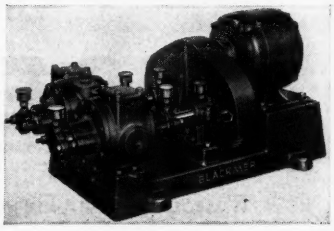
DART UNIONS

E. M. DART MANUFACTURING CO., PROVIDENCE, R. I.

desired time period. Timing begins, not immediately, but when the apparatus reaches the desired control point, no matter how long or short a time that may take. At the end of the timed period the process timing mechanism automatically ends the process. Several variations of the instrument are available so as to assure maximum usefulness over a wide range of specific applications.

Twin Pumping Unit

DESIGN and operating data on a new twin pumping unit have recently been released by the Blackmer Pump Co., Grand Rapids, Mich.



The specifications of the new unit are as follows: Two standard Fig. 4202, No. 50 pumps mounted on a cast bedplate and connected through semi-enclosed reduction gears to an electric motor. Pump constructions available are all-iron, bronze-fitted or all bronze. Capacity of each pump is 3 gpm at a discharge pressure of 100 psi. Pump speed is 570 rpm. Unit is designed to handle fuel oil, lube oil and similar liquids.

These units will later be available in larger capacities and high pressures for industrial applications where it is desirable to handle two different liquids through the same pumping unit simultaneously. Similar twin units are now available with clutches to permit either alternate or simultaneous operation of pumps.

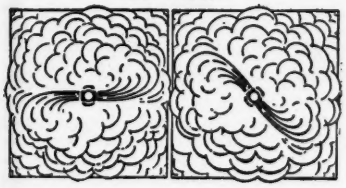
Flip-Open Fuse Cutout

OVERCURRENT protection by means of a fuse link but without the conventional hinged fuseholder tube, is provided by a flip-open fuse cutout, recently placed on the market by General Electric Co., Schenectady, N. Y.

The cutouts, rated 50 amp, 7500/12,500 and 15,000 v, have clamp-type line

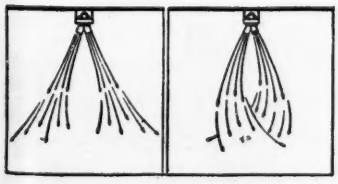
"HEATING NEWARK BAY"

TOP VIEW



SWEEPING AIR FLOW

ELEVATION



AIR BLANKET

That's the phrase the Northern Air Conditioning Corporation of Newark, N. J., used to describe an installation of Wing Revolving Unit Heaters they made recently.

The problem put up to them was that of providing a working temperature of 55° in a boat shed the "floor" of which was largely the surface of Newark Bay. Because of the heat absorbing qualities of this unusual "floor" it was decided to lay a protecting blanket of warm air over the working area, much as the Navy lays a smoke screen over the water to protect naval operations from prying eyes.

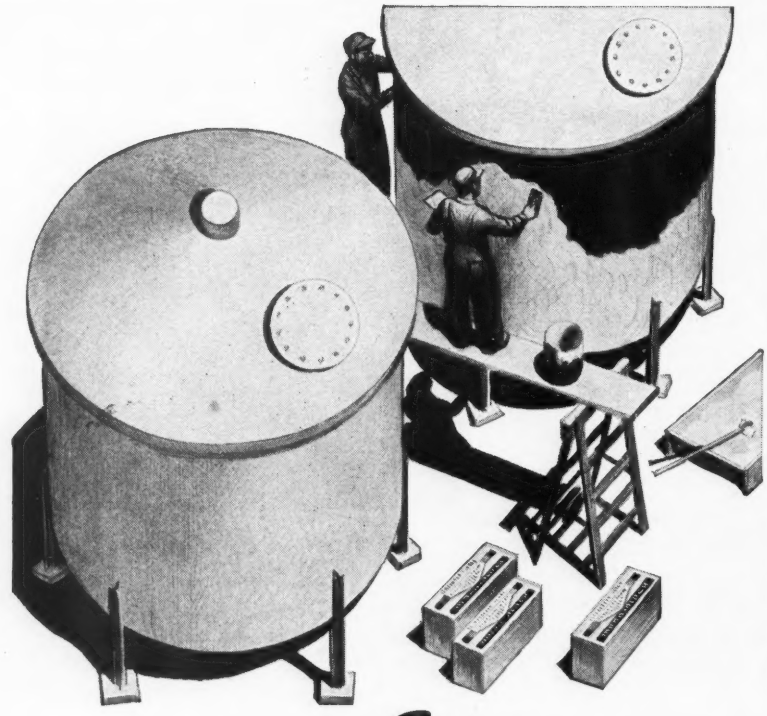
The largest size Wing Revolving Unit Heater was installed and is now in successful operation, laying a continuous blanket of warmed air above the entire working area, with minimum temperature differential and controlled air flow at a level of 5 feet above tidal water.

This is a remarkable example of the way in which *controlled* heating can be maintained by means of the *Revolving* Unit Heater. The wind around this installation is seldom below 20 miles per hour and the mercury shrinks well to the zero mark, yet the continuous blanket of warm air from the revolving discharges of the Wing heater keeps the working area at a comfortable temperature. It is obvious that no other form of heating could accomplish these results.

You may not have a heating problem as unique as "heating Newark Bay" but it will pay you to investigate Wing Revolving Unit Heaters.

L. J. Wing Mfg. Co.

64 Seventh Ave., New York 11, N.Y.
Factories: Newark, N. J., Montreal, Canada



Extra

Insulation Savings with

MONO-BLOCK

B-H Mono-block is effective over the entire temperature-range up to 1700° F. Because it is efficient over so many different temperatures, an installation of Mono-block may eliminate the necessity of using two different types of insulation for the one job.

Made of *black* rockwool, Mono-block is high-temperature-resistant and has exceptionally low thermal conductivity. Long, straight fibres are specially interwoven in layers by an exclusive patented process that makes it lighter, more efficient. This means important savings, too.

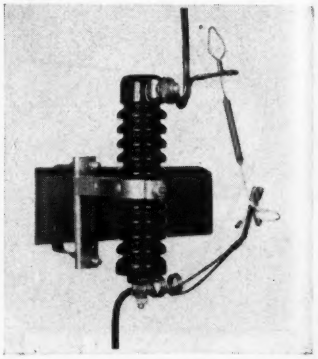
Mono-block is easy to cut and easy to apply. Its felted surface yields to rivet-heads, welds, and other surface irregularities without cracking or breaking. Send for sample and new booklet. *Baldwin-Hill Co., 577 Klagg Ave., Trenton 2, New Jersey. Plants in Trenton, N. J., Kalamazoo, Mich., and Huntington, Ind.*

Baldwin-Hill

BH COMPANY

HEAT & COLD INSULATIONS

terminals, wet-process solid porcelain insulator, and spring contact arms. The fuse is supported in tension between spring contacts.



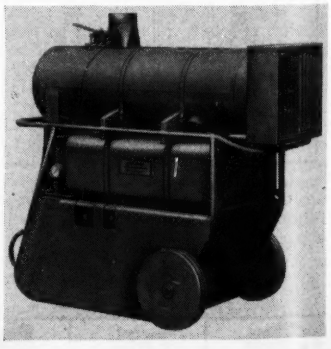
When the fuse link blows, the spring tension of the contacts widely separates the severed ends of the link, thereby giving visual indication of the blown fuse from the ground at any angle. A switch stick is used to re-fuse the cut-out.

The fuse link is constructed with solid wire rings at both ends to permit easy handling with a switch stick. The ampere rating is stamped on the swaged top terminal of the fuse link. The flexible tinned copper cables are of high tensile strength. An enclosing tube of Textolite covered fiber protects the fusible element from the weather.

Portable Multi-Service Heater

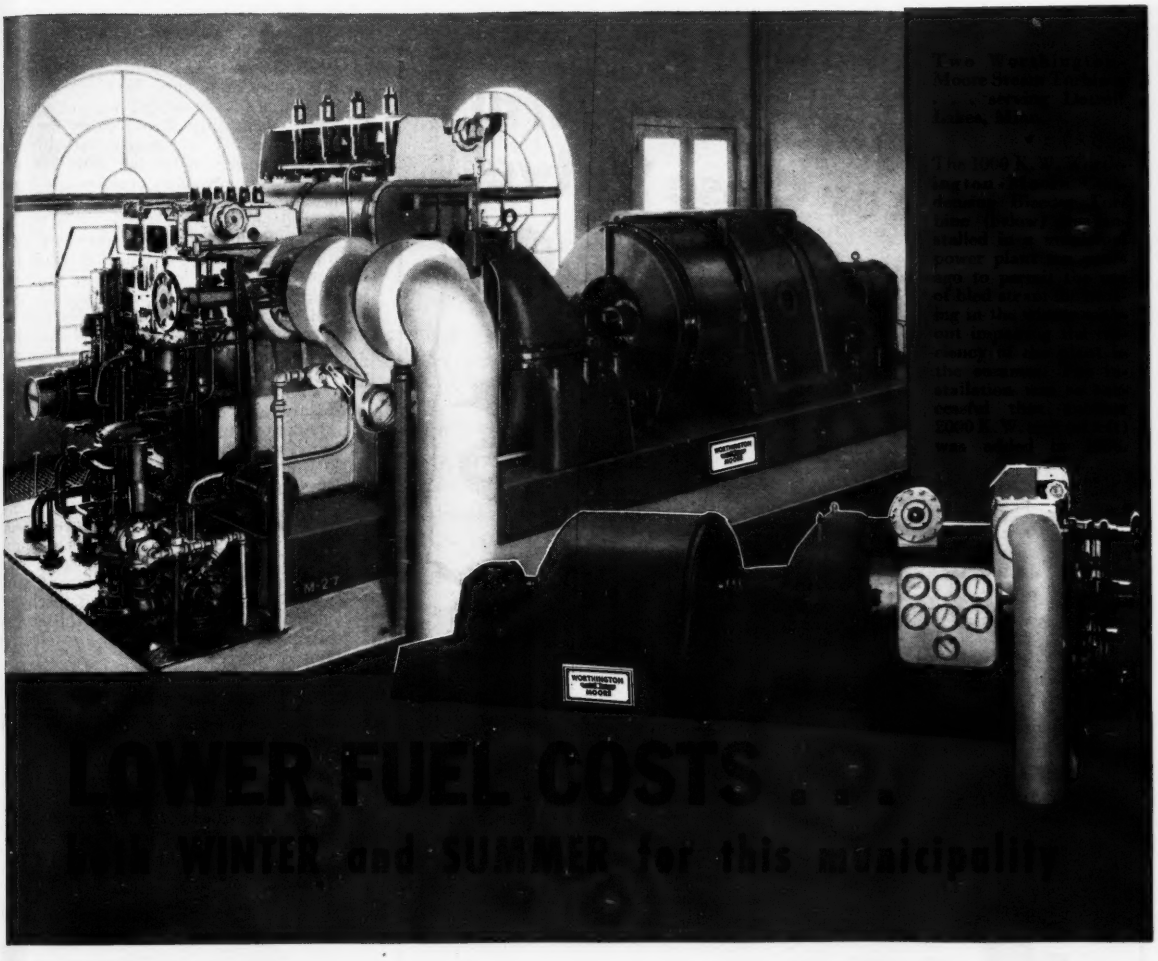
A NEW PORTABLE HEATER which can be used in countless applications is announced by Surface Combustion, Toledo, Ohio.

The new "Janitrol" portable heater embodies the "whirl flame" combustion principle which permits instant lighting in sub-zero temperatures. It also makes it impossible for the heater to "blow out" regardless of temperature, altitude or air density. This "blow-out"-proof quality of the unit results from the fact that ignition is continuous and the combustion process "self-piloting." The flame is made to whirl by tangential introduction of air into the combustion chamber. It becomes a tightly-wound spiral resulting in complete combustion.



This new portable heater uses liquid fuel. It will operate on any grade of gasoline. Kerosene may also be used and, with minor modifications, the unit will operate on other liquid fuels.

Equipped with gasoline-engine or electric-motor drive, and mounted on a



When electrical and heating requirements vary widely at different periods or seasons, there is bound to be an excess of fuel consumed unless there is suitable provision on the installation for balancing the heat and electrical loads. Worthington-Moore Condensing Bleeder Turbine Generator Units are ideal for such conditions.

The two units illustrated above operate with steam at 350 lb. gauge-pressure, 635° F. total temperature, exhaust to 28" vacuum and extract steam at 10 lb. gauge pressure for heating. Both of these units give efficient operation straight condensing during the summer months and provide bled steam for municipal heating purposes during the winter.

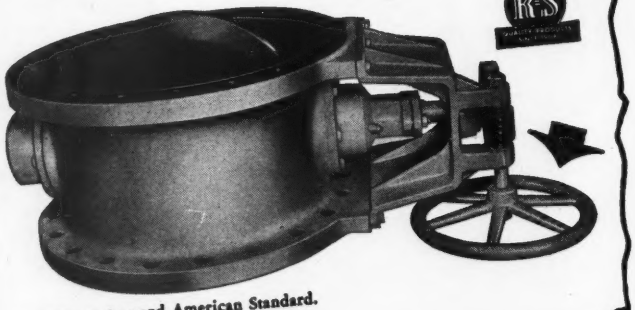
Moore Engineers will be glad to study your electrical and heating requirements and give you an estimate of the fuel savings possible with a Worthington-Moore Unit.

WORTH BEHIND THE NAME
WORTHINGTON
MOORE

MR4-2

WORTHINGTON PUMP AND MACHINERY CORPORATION, HARRISON, NEW JERSEY • MOORE STEAM TURBINE DIVISION, WELLSVILLE, NEW YORK

4 to 6 Hand Wheel Turns Open or Close Valve



No. 502—125-pound American Standard. Ball bearing mounted with stuffing box.

The quick operation of R-S Butterfly Valves is readily apparent. This is an important feature in any application but it is especially important where a battery of synchronous-driven pumps discharges into a common header. Burned-out motors at start-ups can be practically eliminated when R-S Butterfly Valves are installed, since it requires only a few seconds of an operator's time to shut off the discharge valves until the pump has gained the desired speed. The valves are then opened gradually, of course.

Equipped with hand wheel or chain wheel control, the standard 125-pound valves not only fulfill all requirements to better advantage, but cost less to purchase and install than conventional type valves.

No. 501—20-inch, 125-pound American Standard. Declutching unit (patent applied for) permits operation with either hand wheel or hydraulic cylinder.

NO SLAM—NO LINE DAMAGE

The 125-pound valve, equipped with hydraulic cylinder for power operation, prevents a synchronous-driven pump from grabbing all the load when the pump is started, prevents reverse flow and eliminates water hammer since the valve cannot move any faster than the bleeding of the cylinder discharge permits.

Straight-through flow—control and shut-off for any material that flows or is forced through a pipe.

Constructed in sizes to 84-inches and for 15 to 900 psi. Write for Catalog No. 14-B.

VALVE DIVISION

R S PRODUCTS CORPORATION

4535 Germantown Ave. • Philadelphia 44, Pa.

R-S Streamlined BUTTERFLY VALVES

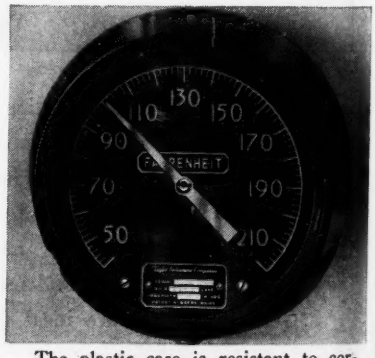
two-wheeled carriage, the unit can be moved in wheelbarrow fashion or can be pulled sled-fashion over snow, ice or mud. Draw and push bars, as well as lift bars, are incorporated into the frame. Ease of portability is assured by the fact that the center of gravity is directly over the wheels when the unit is lifted to the most convenient position for hand wheeling. The weight of the unit is thus balanced on the wheels.

Among the specific features are that both engine and combustion exhaust gases pass out of one common flue, requiring only one stack; any unburnt gas from the engine exhaust is burned in the combustion chamber; and venting engine exhausts into the combustion air blower reduces engine noise. The circulated air is delivered by a positive-pressure type blower.

Output rating of the Surface Combustion portable "Janitrol" heater, 250,000 Btu per hr; temperature rise, 230 F; tank capacity, 25 gal, sufficient for 8 hours' operation; weight, 270 lb, tank empty less ducts; speed of blower, 2400 to 2450 rpm; speed of pump, 420 rpm; speed of gasoline engine, 1850 rpm; rating of engine, 2.6 hp; ducts, two of 8-in. diam 20 ft long; ignition, hand torch, or combination hand and spark ignition, as desired; unit also adaptable for electric motor drive.

Dial Thermometer

THE NEW 4½ in. Phenolic case dial thermometer announced by Taylor Instrument Companies, Rochester, N. Y., is a mercury actuated instrument built to withstand severe operating conditions. Since it is available with Accuratus Tubing, it is especially well suited to installations requiring a long length of tubing between the bulb and the instrument.



The plastic case is resistant to corrosion and shock, and to make reading at a distance easy the metal dial is finished in black with white figures.

This 53K series mercury actuated dial thermometer can be had with a wide variety of standard temperature-sensitive bulb constructions.

Conveyor-Elevator System

A NEW CONVEYOR-ELEVATOR system to be known as the Rex Uni-Flo has been announced by Chain Belt Co. of Milwaukee. This type of conveyor is a new method for the mass handling of free-flowing bulk materials.

The new Rex Uni-Flo is a conveying unit of the continuous-stream type. It is composed of a chain belt equipped, closely-spaced, scraper-carrier flight, which operates in an enclosed casing. With the entire cross-section of the casing and all the space between the flights solidly filled with the material being

THEY DID NOT FAIL...

In the very foreground of the dramatic production of fighting machines and materials, operate the Public Utilities, supplying power at a rate never before attained. With this in mind it is easy to visualize the LOSS of time and production that can be caused by the failure of a boiler . . . halting generators until boiler tubing is replaced.

Doubly important, therefore, is the quality of boiler tubes in the Nation's power plants. Babcock & Wilcox realizes its responsibility to the war effort. B&W boiler tubes, produced in the world's largest specialty tube mills, are made to give the longest possible continuous service . . . even under pressures as high as 2500 psi, and temperatures up to 900 F.

The unusual boiler problems born of the emergency have yielded valuable new experience which will be available for the development of peace-time industry.

TA-1276

B&W TUBES

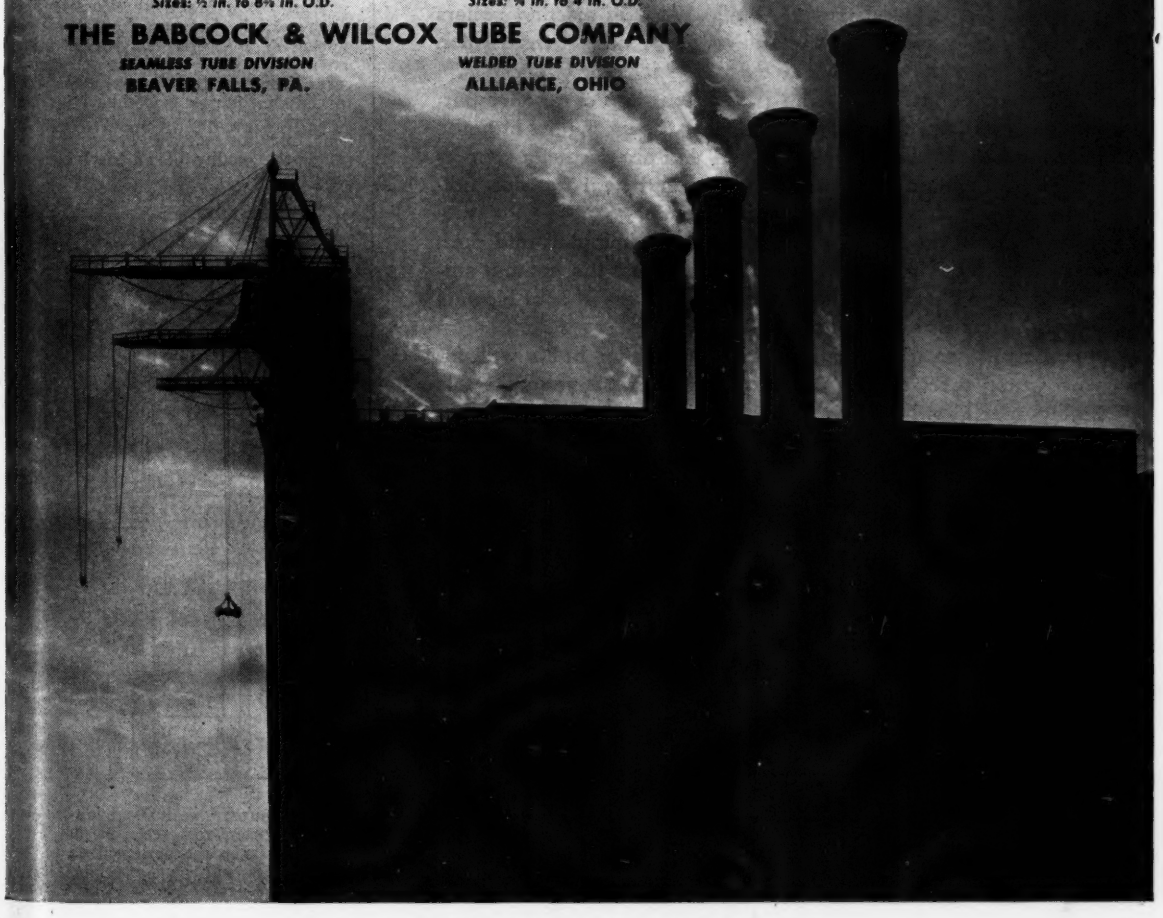
SEAMLESS
Complete range of carbon and alloy steels
Sizes: ½ in. to 8⅝ in. O.D.

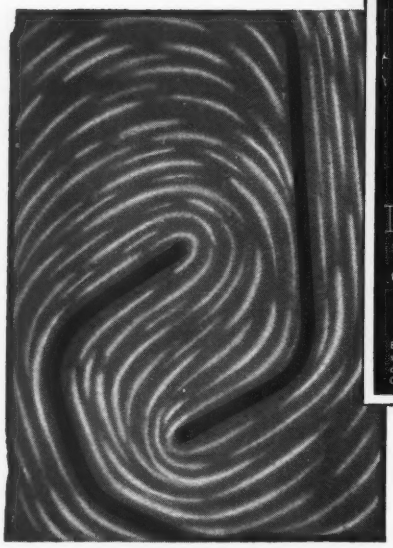
ELECTRIC-RESISTANCE WELDED
Carbon grades
Sizes: ¾ in. to 4 in. O.D.

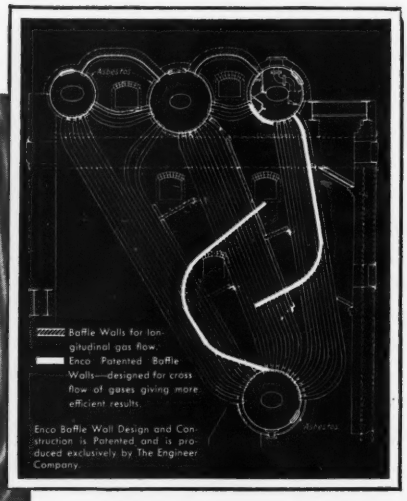
THE BABCOCK & WILCOX TUBE COMPANY

SEAMLESS TUBE DIVISION
BEAVER FALLS, PA.

WELDED TUBE DIVISION
ALLIANCE, OHIO






Baffle Walls for longitudinal gas flow.
Enco Patented Baffle Walls—designed for cross flow of gases giving more efficient results.
Enco Baffle Wall Design and Construction is Patented and is produced exclusively by The Engineer Company.

CORRECT BAFFLES SAVE FUEL!

Too often it is found that the Baffle Walls in existing boilers were originally located with a view to low cost of installation rather than in the most effective position for efficient results.

Enco Baffles increase steam production, improve boiler performance and save fuel, by streamlining the cross flow of gases over the boiler tubes through passes that are correctly proportioned to maintain the proper velocity and heat transfer, utilizing every square foot of heating surface.

Bottle necks and dead gas pockets are eliminated and draft losses reduced. The rapid flow of gases across the heating surface tends to clean the tubes, cutting down use of soot blowers — a further saving in steam.

It may be we can design and build a better baffle wall for *your* water tube boiler. Our experience of 25 years in this highly specialized branch of engineering is available to you.

Send us your boiler print and ask for a new baffle design. No obligation to you.

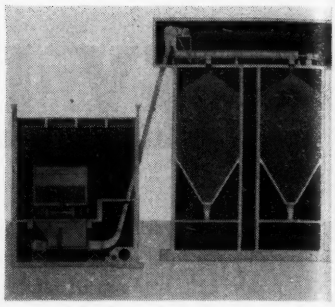
ENCO STREAMLINE BAFFLES
Produced exclusively by The Engineer Company

FREE BOILER BAFFLES

● ***A bulletin on boiler baffles gives valuable information which every engineer should have. Ask for bulletin BW 44. It's free.***

THE ENGINEER COMPANY
75 WEST STREET • NEW YORK 6, N. Y.

Enco Streamline Baffles
PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY



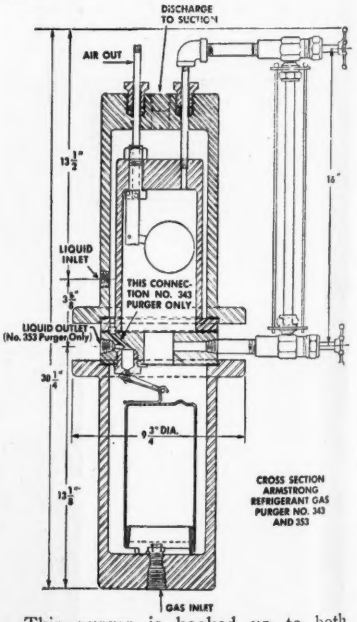
handled, a continuous flow of material results.

Rex Uni-Flo has a positive discharge mechanism that definitely removes all material in the conveyor system at the point of discharge. It is completely self-feeding and no auxiliary feeding devices are required. It is self-cleaning and causes little degradation of materials. It operates at relatively slow speeds which means longer life and freedom from maintenance worries.

This conveyor is flexible in application with a wide choice of basic units and few limitations as to layout. It can convey material horizontally, vertically, or at any angle. It offers a direct line of transportation by the shortest possible route to conserve valuable productive space. Because it is essentially a closed-circuit method of handling, it is clean and dust-free.

Refrigerant Purger

ARMSTRONG MACHINE WORKS, Three Rivers, Mich., has announced the development of a forged steel purger for removing air and other non-condensible gases from refrigerating systems. The forged steel purger is designed for high-pressure CO_2, ammonia and freon systems and for service where engineers prefer the quality of all steel construction.

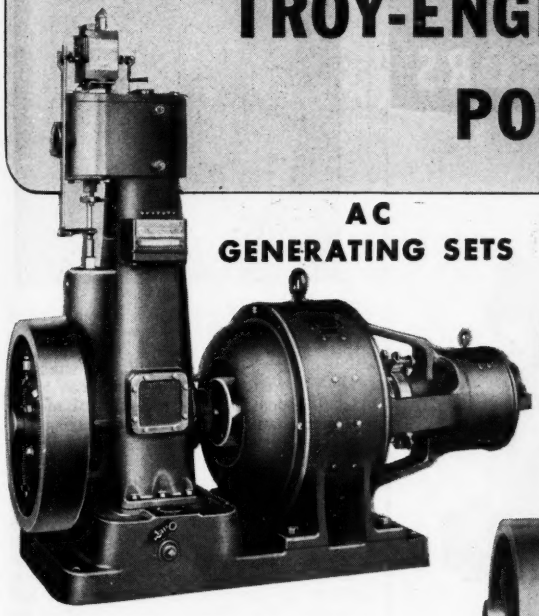

DISCHARGE TO SUCTION
AIR OUT
LIQUID INLET
THIS CONNECTION NO. 343 PURGER ONLY
LIQUID OUTLET (No. 353 Purger Only)
9 3/4" DIA.
CROSS SECTION ARMSTRONG REFRIGERANT GAS PURGER NO. 343 AND 353
GAS INLET

This purger is hooked up to both the condenser and receiver and is reported to keep the system free of non-condensibles with no appreciable loss of refrigerant gas.

Let Plans for POST-WAR *include*

TROY-ENGBERG BY-PRODUCT POWER UNITS

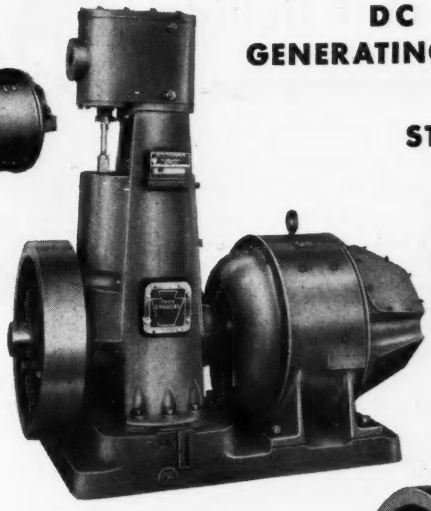
AC GENERATING SETS



for (1) providing power for week-end, holidays or night loads in large plants

(2) as the main power source in small plants

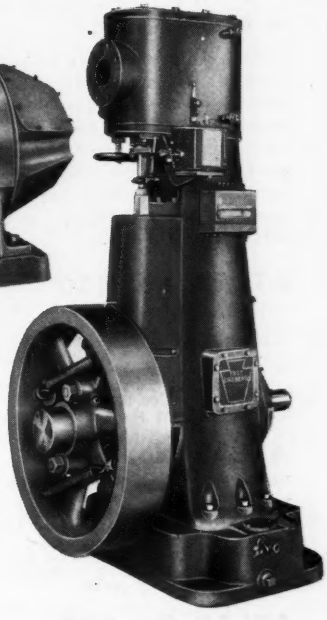
DC GENERATING SETS



for (1) plants equipped with DC motors

(2) for lifting magnets

STEAM ENGINES



for driving stokers, pumps, fans, compressors, blowers, generators, cookers, dryers, etc

. . .

Horizontal engines are available for all uses

BY-PRODUCT Power by its very nature is cheap power. Every plant that is planning in its post-war production to use steam for processing or heating is a plant that should investigate the possibilities of developing and using by-product power. Troy-Engberg Sets and Engines, listed above, are all By-Product Power units. Under proper conditions they can produce power at a lower cost than any other power unit.

TROY ENGINE & MACHINE CO.

Established 1870

863 Railroad Avenue **Troy, Pennsylvania**

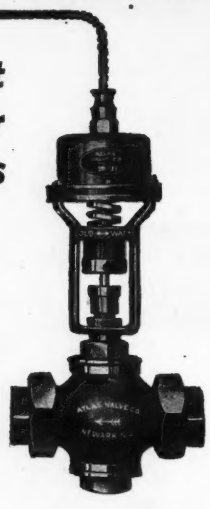
5-TEM-

ATLAS

Self-Contained

TEMPERATURE REGULATORS

Maintain perfect control of water and other liquids



Control the temperature of water and other liquids on all kinds of open or closed tanks or heaters which are heated by steam or gas.

These units consist of a boiler and a motor consolidated into one machine. The control bulb is the boiler, and the vapor is generated by heating the thermostatic liquid contained within it. The pressure resulting is transmitted through capillary tubing to a one-piece metallic bellows, which, expanding, acts as the motor for operating the valve which regulates the admission of the steam or gas used to generate the heat. The control valves operated by bellows have seats suitable for the service.

ATLAS No. 650

Balanced Type Double Seat Valve. Spring Adjustment. For temperatures from 70° to 300° F. Bulb is immersed in liquid and control valve installed in steam supply. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", and 2½" for steam pressures up to 100 lb. Operates in vertical or horizontal position.

ATLAS No. 651

Needle Type. Single Seat Valve. Spring adjustment. For temperatures from 70° to 300° F. Used where tight seating valve is essential such as on small oil heater pump sets, open or closed tanks, sterilizers, glue heaters, etc. ½" and ¾" for steam pressures up to 150 lb. Operates in vertical or horizontal position.

ATLAS No. 655

Balanced Type. Double Seat Valve. Lever and Weight Adjustment. For temperatures from 70° to 300° F. Lever and weight adjustment of control valve assure high sensitivity. For maintaining temperature of liquids in all kinds of tanks and heaters. ½", ¾", and 1" for steam pressures up to 150 lb. 1¼", 1½", 2", 2½", 3", 4", 5", 6", and 8" for pressures up to 100 lb. Operates in horizontal pipes.

ATLAS No. 660

Single Seat Self-Contained Pilot Operated Valve. Spring Adjustment. For temperatures from 70° to 300° F. For use where accurate regulation demands a quick opening and closing control valve and where steam pressure is always 25 lb. or more, as for instantaneous heaters and tanks for water, oil, etc. ½", ¾", 1", 1¼", 1½", and 2" for steam pressures up to 300 lb. 2½", 3" and 4" for steam pressures up to 250 lb.

Write for Bulletin 7A giving detailed information

Other ATLAS Products

Check this list and mail to us with your name, firm name and address.

- ☐ Damper Regulators
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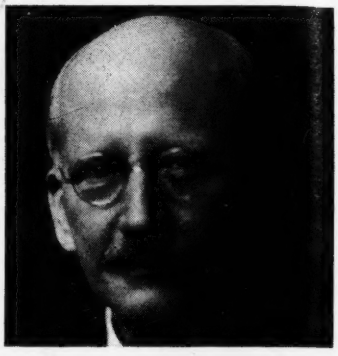
OBITUARIES

George A. Orrok



GEORGE A. ORROK died at his home in Riverside, Conn., after a short illness, on April 6 at the age of 77 years.

Internationally known to the engineering profession as a man who has had a leading position in the design of modern power plants, Mr. Orrok's passing will be felt deeply in the hearts of many men who have benefited by his expressed ideas and engineering teachings throughout the long period in which power engineering has progressed from locally applied, purely mechanical systems to the nationwide electrical distribution systems of today. In every phase of power plant development during the past half century Mr. Orrok has implanted his ideas, the benefits of which will be felt for many generations.

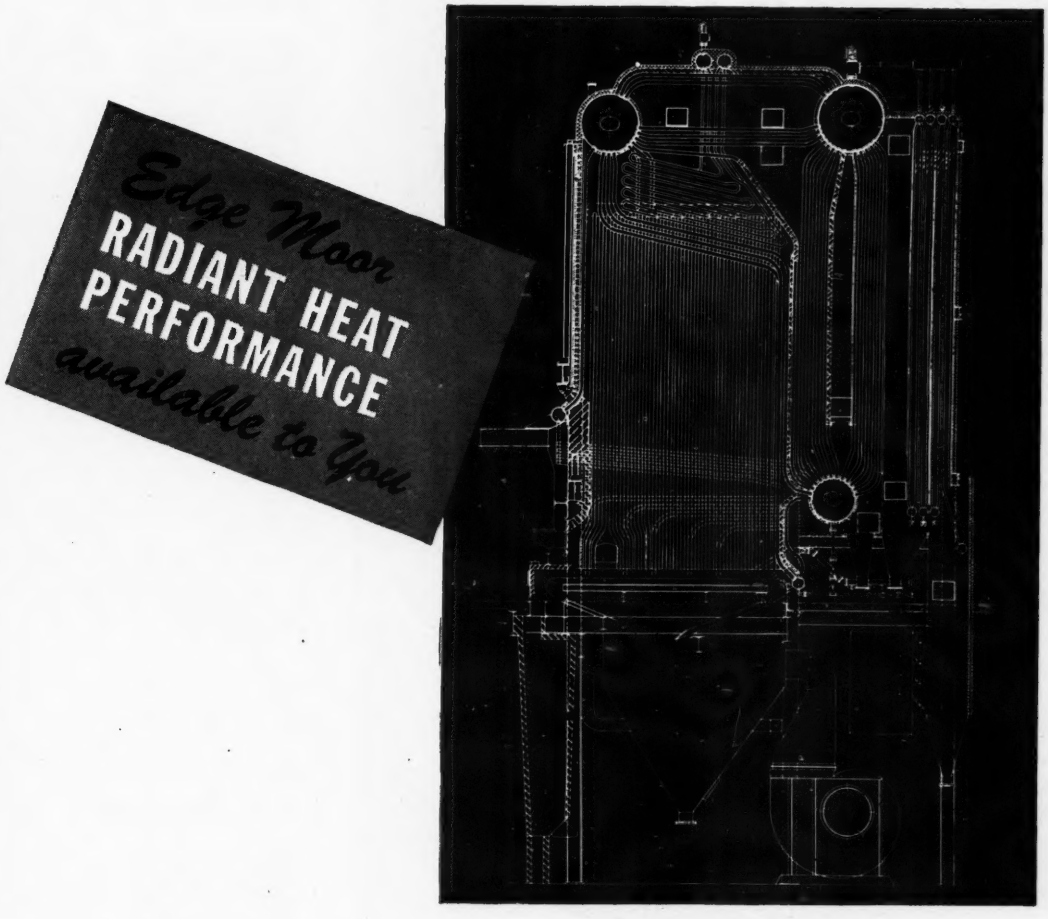
He was born in Dorchester, Mass., in 1867 and received his formal engineering education at the Massachusetts Institute of Technology but throughout his long life he continued to add to his store of knowledge through experience in engineering projects and constant contact with leaders in scientific fields. Two years were spent in teaching mechanical engineering, followed by six years in miscellaneous design and construction work including street railways and coal mines. In 1898 he joined the New York Edison Co. as draftsman, advancing through the company's organization to consulting engineer in 1917.

Research work in the field of heat transfer in condensers and furnaces, and properties of high-pressure steam engaged a considerable portion of his time. In the educational field, he taught steam engineering at the Brooklyn Polytechnic Institute from 1911 to 1914; lectured in his special field at Yale, Harvard and Princeton University; received an honorary degree in Mechanical Engineering from Stevens Institute of Technology in 1929; was given Honorary Membership by the American Society of Mechanical Engineers in 1936; was co-author with Professor Fernald of a textbook on the Engineering of Power Plants.

He contributed numerous papers to engineering and scientific societies as well as the technical press; his work in engineering societies and for foreign clients took him to Europe on many occasions.

Since 1931 Mr. Orrok has been associated with David Moffat Myers and W. A. Shoudy in independent consulting practice, serving as consultant on many important foreign as well as domestic engineering projects. He was also a partner in the architectural engineering firm of Binger-O'Connor-Orrok.

EDGE MOOR WATER TUBE BOILERS



The Edge Moor radiant heat unit illustrated is designed for a maximum evaporation of 120,000 pounds per hour with a drum pressure of 500 pounds and at 800° final steam temperature. In service at a mid-western central station, it has delivered up to 150,000 pounds of steam per hour. The design takes full advantage of water walls, superheater and economizer. Low grade bituminous coal is fired on a spreader stoker.

This and many other Edge Moor units —in a wide range of types, capacities, pressures and accessory equipment—can be duplicated by Edge Moor with worthwhile savings in time. Our fabricating facilities are geared to go into production promptly on your requirements.

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Among his close relatives, Mr. Orrok leaves a widow, Elene Geer Orrok, a son, George A. Orrok, Jr., and a brother, Henry Orrok.

Matthew O. Troy

MATTHEW O. TROY, a commercial vice president of the General Electric Co. died suddenly on March 13.

Mr. Troy was born December 15, 1872, in Burlington, N. C. He attended the University of Virginia where he received the degree of bachelor of science in electrical engineering in 1896 and came to Schenectady in January of 1897. He was on test there for three months, and then went to Lynn, Mass., on test work for six months. He was made head of the transformer testing department at Lynn and during that period was associated with the late Dr. Elihu Thomson. He left test to join the General Electric engineering department where he remained until 1904.

He returned to Schenectady to serve as commercial engineer in the transformer division and later became manager of the division. He went to Pittsfield when the division was transferred to the Works there.

Mr. Troy returned to Schenectady again in 1923, after 10 years, as executive assistant manager of the Central Station Divisions. From this position he was promoted first to manager of the Division in 1928 and then to commercial vice president.

M. E. Thompson

M. E. THOMPSON, electrical industry pioneer and inventor, died at his home in Ridgway, Pa., April 5 at the age of 80, after a long illness due to a heart condition. Mr. Thompson was employed as consulting engineer for Elliott Co. at the time of his death, being the oldest employee on the active list of the Ridgway Division. He had previously been chief engineer of the Ridgway plant.

He was a native of Greenfield, Ohio, received his B.S. degree in electrical engineering at Cornell University in 1890. His post-graduate work as assistant to Dr. Harris J. Ryan, professor of electrical engineering at Cornell and, later, at Leland-Stanford University, led to tests on the first electrical generator equipped with compensating windings, designed by Dr. Ryan.

As a result of these tests, Mr. Thompson designed, in 1893, the 10-kw, 110-v, six-pole belted generator now displayed in the Edison Institute at Dearborn, Mich.

Necessary modifications of this machine led Mr. Thompson to invent, within a few hours of its first test run, a combination of commutating pole and compensating winding, with the latter carried by a continuous ring separate

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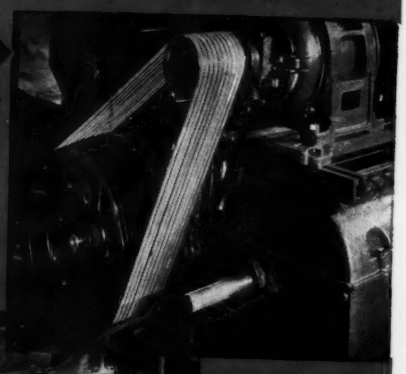

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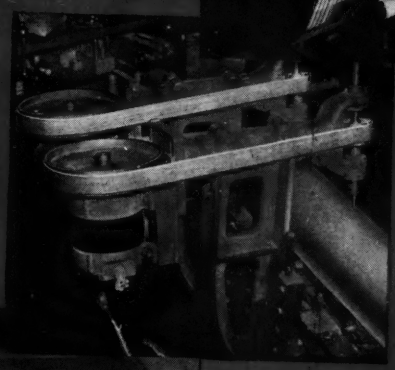
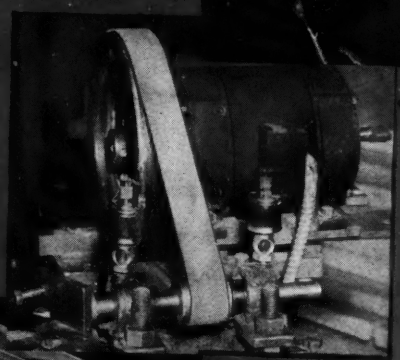
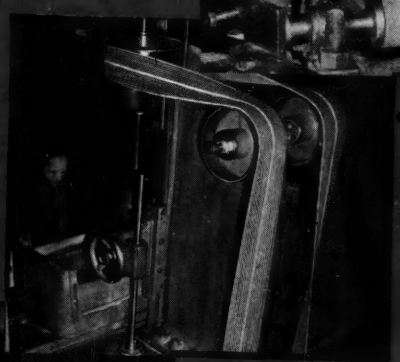


GILMER HEVALOID ENDLESS BELTS: Made under the Hevaloid patent with Neoprene compound that provides high coefficient of friction. For precision work at top speed of 9000 f.p.m. Resists oil, heat, stretch and slippage.



GILMER SPEEDAGE BELTS: Very light, lapless, flat, fabric belts for high speeds to 10,000 f.p.m. and over. Assures chatterfree production.



GILMER KABLE KORD BELTS: Rubber Fabric and tough continuous cord construction give you a contactor and power belt in one. Exceptional grip and strength combine in these flat belts with low-stretch, small slippage and extra tensile strength.

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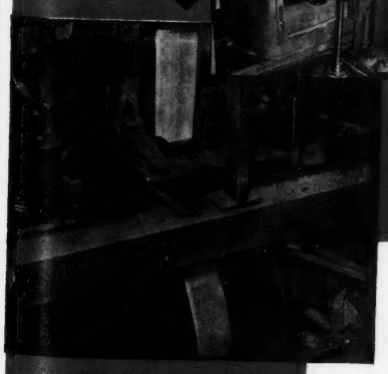

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from the rest of the field structure. He thus first established the fact that the compensating winding could perform a two-fold function in creating a fixed and properly proportioned commutating field for all load conditions, and in preventing distortion of the main field by armature reaction.

While still a student at Cornell, Mr. Thompson also invented the first practical alternating-current watt-hour meter of the motor type, involving the same general principle used in such meters today. In addition, he made an exhaustive study of the magnetic properties of iron and steel. Mr. Thompson also made many contributions to the design of steam engines and other power plant equipment.

The Ridgway Division of Elliott Co. was a major interest in Mr. Thompson's life. His training and assistance were of special value to younger engineers, and his help in the problems of electrical design, and in the techniques of electrical and mechanical engineering, was of substantial aid in the development and growth of the company. Mr. Thompson leaves his widow, the former Marion McCann; and a daughter, Mrs. A. T. Kelley, of Toledo. A sister, Mrs. Anthony Sharp of Terre Haute, Ind., and a grandson also survive.

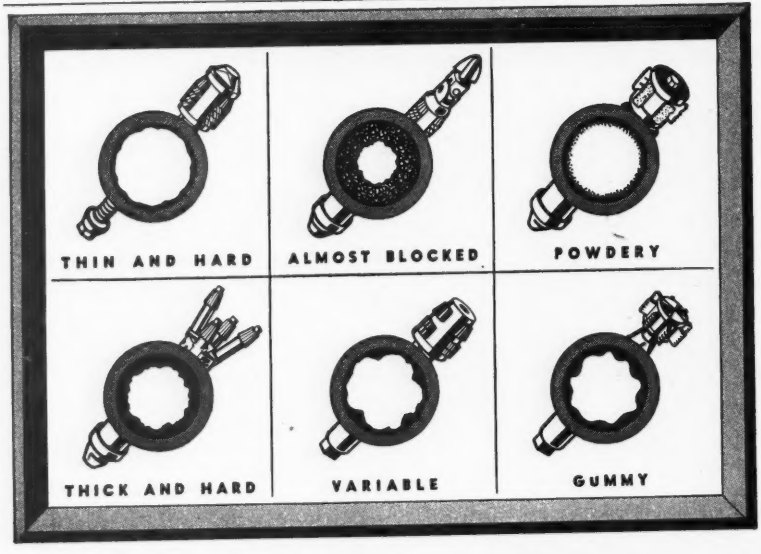
Albert Blake Williams

A. B. WILLIAMS, Consulting Engineer, Stone & Webster Engineering Corp., died at his home in Brookline, Mass., on March 29.

Mr. Williams for many years a resident of Brooklyn, New York, and a member of Battery A in that borough, was born in Jersey City, N. J., May 22, 1884. He was graduated from Cornell University with the degree of M.E. in 1906. After several years in contract piping work, he entered the employ of the Interborough Rapid Transit Co., where he began his career in the field of steam power plant engineering. Mr. Williams rose rapidly to the post of Construction Engineer; he had charge of the design and construction of additions to the Interborough power stations at 59th Street and 74th Street, which accompanied the great expansion of the New York Subway system during that period. These installations included the largest and most efficient turbine generators that had been designed up to that time.

In 1919 Mr. Williams became associated with Stone & Webster Engineering Corp. He was placed in charge of many outstanding utility and industrial installations, including the South Meadow Station at Hartford, Conn., and the Edgar Station at Weymouth, Mass. The latter was the first 1200 psi installation in the United States. In 1926 he became Chief Mechanical Engineer. In 1929 he was appointed Assistant Engineering Manager in charge of the Mechanical, Power and Industrial Divisions, and in 1941 was given the title of Consulting Engineer. Mr. Williams was an outstanding authority on high pressure piping, and in spite of the breadth and scope of his work in directing all of Stone & Webster's mechanical engineering designs for a number of years, he maintained an unflagging interest in that specialty.

Mr. Williams was a member of the ASME, the Cornell Clubs of Boston and New York, and Cornell chapter of Phi Kappa Psi. He is survived by his wife, Frederica Howell, and two children, Albert Blake, Jr., and Frederica.



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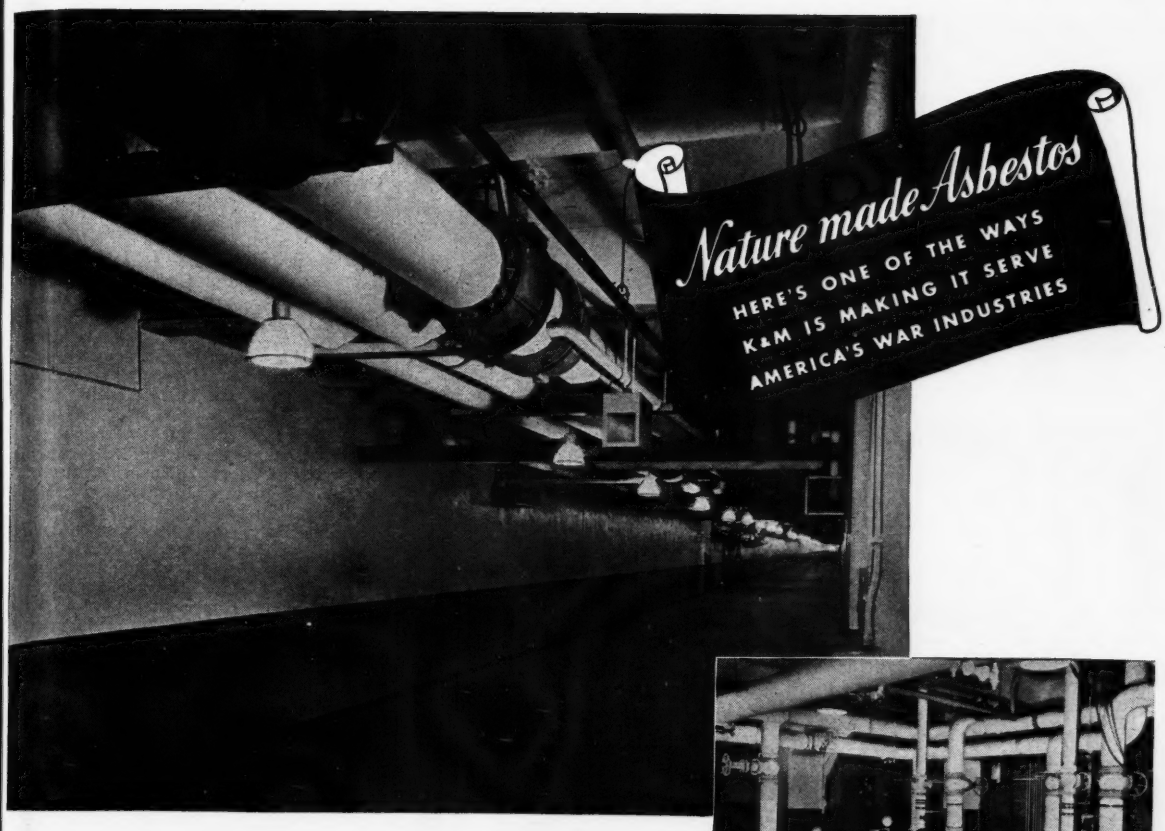
MANUFACTURERS' PERSONALS

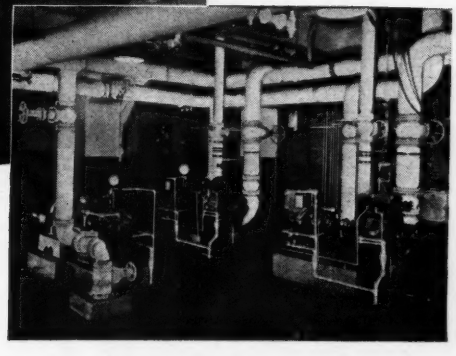
R. O. Muller, because of continued ill health, has retired as Chief Engineer of The Terry Steam Turbine Co. and Douglas S. Seelye was appointed to the position of Chief Engineer. Mr. Seelye is a graduate of Yale University and has been connected with the Engineering and Sales Departments of the company for the past twenty-four years.

Al J. McCullough and Jack E. MacConville have been placed in joint charge of industrial instrument sales for the Brown Instrument division of the Minneapolis-Honeywell Regulator Co. at its Cleveland, Ohio, office.

W. E. Bisler, recently District Manager for Pomona Pump Co. at Pittsburgh and formerly with Combustion Engineering Co., is now serving as Industrial Engineer for Dowell, Incorporated. Mr. Bisler is attached to the New York office of Dowell, a subsidiary of The Dow Chemical Co.

D. J. Peterson, who has been manager of the Detroit branch of Minneapolis-Honeywell Regulator Co., has been placed in charge of the heating control division of the entire Cleveland zone, with headquarters in Detroit. This area includes territories covered by Cleveland, Detroit, Buffalo, Cincinnati and Pittsburgh. Mr. Peterson has





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It takes plenty of steam—as well as gun powder—to fight this kind of a war. For example, here is a typical war plant which uses as much as 300,000 lbs. of steam per hour!

Throughout the power plant of this great factory, K&M Insulation is reducing heat loss . . . saving fuel and power . . . eliminating unnecessary expense.

K&M "Featherweight" 85% Magnesia reinforced with asbestos fibre, is recognized as one of the most efficient insulators ever developed. It's extra durable, too—undamaged by water or steam leakage. For temperatures up to 600 F., the efficiency, durability and economy of K&M "Featherweight" have never been surpassed.

If you have an insulation problem in your plant, let Keasbey & Mattison, or an approved K&M distributor, help you solve it. Keasbey & Mattison know how to make asbestos serve new purposes—and serve the old ones *better!*

Our Ambler plants proudly fly the Army-Navy "E" flag—an honor awarded K&M employees "for outstanding production of war materials."

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FULLY AUTOMATIC
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NO BOTHERSOME AFTER ADJUSTMENTS
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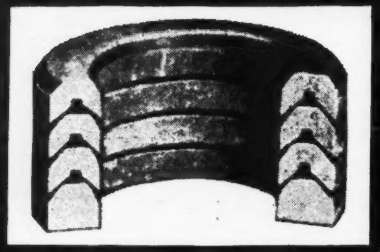

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been with the Minneapolis-Honeywell Regulator Co. for the past 18 yr.

Paul L. Goldstrohm and George M. Muschamp have been elected members of the board of directors of the Brown Instrument Co., Philadelphia. Mr. Muschamp is vice president in charge of engineering of the Brown company, a division of Minneapolis-Honeywell Regulator Co., and Mr. Goldstrohm is vice president in charge of production.

Harold E. Strang, for the past three years engineer of General Electric's Philadelphia Works, has been named to the staff of H. A. Winne, vice president in charge of design engineering, Apparatus Department. Mr. Strang, whose appointment became effective April 1, will be located in Schenectady.

William W. Sproul, Jr., has been appointed manager of the Application Department of the Sharon Works of the Westinghouse Electric and Mfg. Co. Mr. Sproul was graduated from Virginia Polytechnic Institute in 1927 and in the same year he joined Westinghouse as a graduate student. From 1937 until 1942 Mr. Sproul was in the power transformer sales section at Sharon and from 1942 until his new appointment he served as manager of the transformer equipment section.

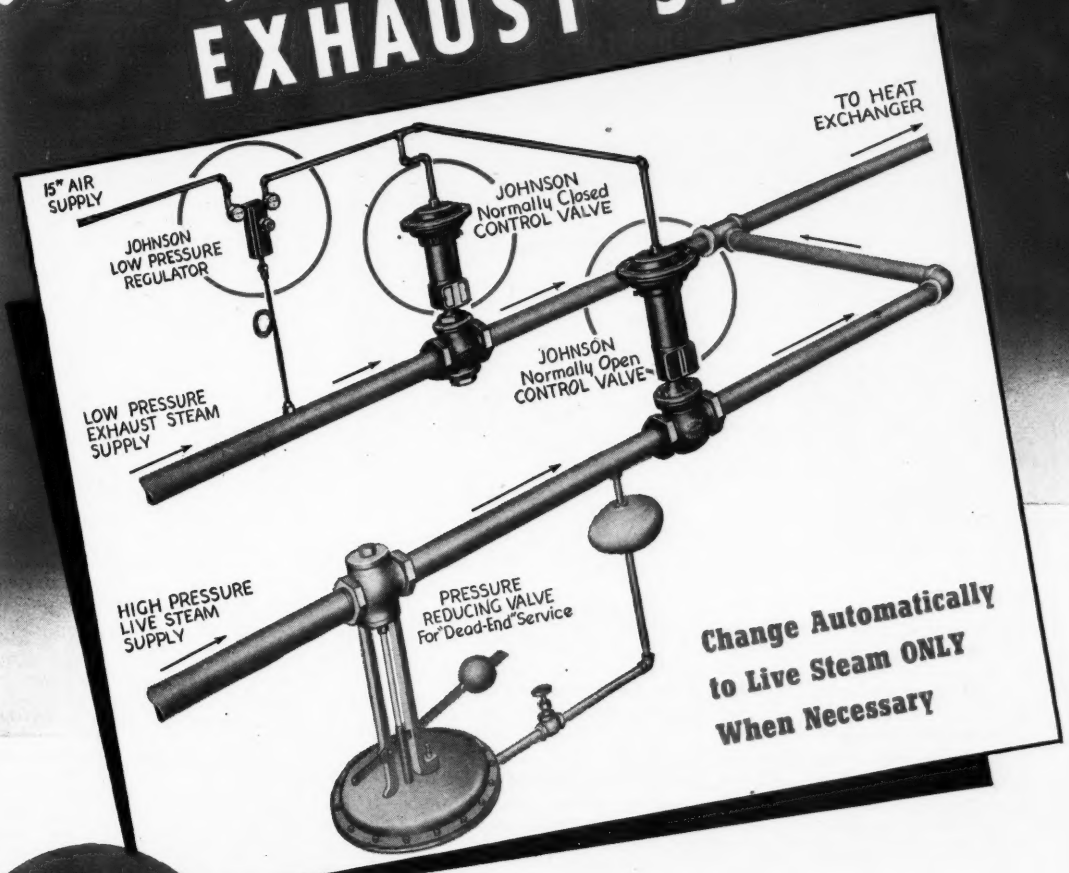
Cutler-Hammer, Inc., Milwaukee, has announced the appointment of G. E. Hunt as acting manager of the company's Atlanta territory with offices and warehouse at 134 Marietta Street, N. W. in Atlanta, Ga. Mr. Hunt has been with Cutler-Hammer since 1920, serving in the New York, Philadelphia, Cleveland, and Milwaukee headquarters offices and, most recently, as manager of Cutler-Hammer's Indianapolis office.

J. K. Gannett, vice president of The Austin Co. and its eastern district manager since 1928, has been appointed director of engineering, in charge of engineering and research for the company. Mr. Gannett joined The Austin Co. as assistant chief engineer in the Cleveland district in 1915, following five years of experience as field engineer, draftsman and designer and supervising engineer for railroad, coal, steel fabricating and engineering companies. He served as Paris manager for the company during and after World War I and was named New York district sales manager late in 1919, continuing in that post until he was named vice president and district manager.

The election of Albert S. Low, vice president of the company, now in charge of its Washington office, and A. F. Plant, vice president and Detroit district manager, as directors of The Austin Co. was also announced. Mr. Low joined the Austin organization as a construction superintendent in 1913 and has served as vice president and chief engineer since 1934. He directed the company's overseas operations immediately prior to the outbreak of war in 1939, and after his return in 1940 was directly in charge of a number of major war projects. Mr. Plant joined the company in 1920 as a designer in the New York office. He has been manager of the Detroit district since 1927 and a vice president of the company since 1938.

Russell E. Ebersole has been appointed lamp sales manager of the Westinghouse Lamp Division. In his

Utilize EXHAUST STEAM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LOW PRESSURE EXHAUST STEAM SUPPLY
HIGH PRESSURE LIVE STEAM SUPPLY
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Change Automatically to Live Steam ONLY When Necessary

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Conserve wartime fuel! Save steam! Save money! Utilize economical *exhaust steam,* whenever possible. . . . The Johnson control hookup, illustrated above, overcomes the principal disadvantage of using exhaust steam for heating coils, heat exchangers and other equipment where low pressure steam is required. When the pressure of the exhaust steam drops to a point where it ceases to be useful, the Johnson "Low Pressure Regulator" closes the Johnson Valve on the exhaust steam supply and opens the Johnson Valve on the live steam supply. A "dead-end" reducing valve is set to deliver live steam at proper pressure. Automatically, without attention of any sort, exhaust steam is used whenever it is available. Live steam "comes to the rescue," only when needed. There is no chance for the lack of proper steam pressure to be overlooked. . . . Another problem solved by Johnson control! Send for bulletins describing Johnson apparatus or ask to see a Johnson engineer from a nearby branch office—no obligation, of course.

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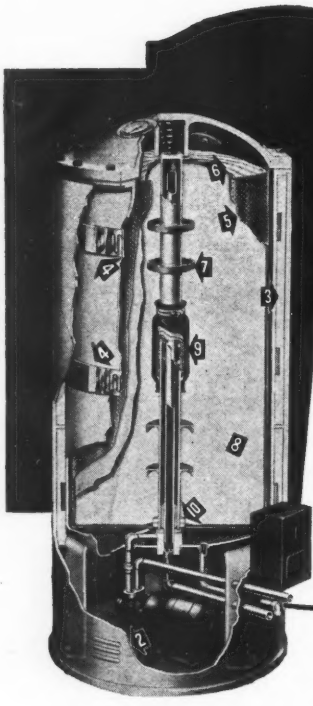

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★ The Advanced Engineering and Design of Honan-Crane "Continuous" Oil Purifiers is the result of more than 20 years of engineering and manufacturing experience in the building of oil purification equipment. Proven and patented features produce outstanding results

Check these important features that have made Honan-Crane an outstanding leader in the oil purification field.

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4. Electric heater bands, steam or water, transfer heat evenly through steel inner wall providing safe and effective operational heat.
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6. Full size refill utilizes all space in purifier.
7. Patented baffle plates guide oil flow insuring thorough purification.
8. "Cranite" fuller's earth purifying medium removes all types of contamination as fast as it is liberated by the operating equipment. Fuller's earth has a great capacity for contamination by both a filtering and adsorbing action.
9. Clean oil inlet guarded by felt, fine mesh metal screen, metal spacer cloth. Screens brazed to center tube.
10. All lines are carefully sealed and gasketed.

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POWER PLANT ENGINEERING

new position, Mr. Ebersole will have charge of all district sales activities of the Lamp Division and will make his headquarters at the Bloomfield plant.

Pipe and Tube Products, Inc., has announced the election of Bernard F. Stolinsky as Chairman of the Board. Previously, Mr. Stolinsky was vice president of the corporation.

Maxim Silencer Co., Hartford, Conn., has announced the appointments of Roland B. Bourne as vice president in charge of research and Frank L. Orr as vice president in charge of sales for the company. Mr. Bourne has directed the Maxim Research Department since 1925 and Mr. Orr has been with the company since November, 1930, when he became district manager of the New York offices.

Edward V. Creagh has been appointed advertising and sales promotion manager of American Chain & Cable Co., Inc., and Associate Companies, Bridgeport, Conn. Mr. Creagh joined the company in 1916 and has been in charge of sales promotion activities since 1936. He was one of the organizers and first president of the Western New England Chapter of National Industrial Advertisers Association and is now serving as a vice president of the National organization.

Kentner L. Wilson has been appointed branch manager of the Minneapolis-Honeywell Regulator Co. Detroit office. Mr. Wilson started with Minneapolis-Honeywell at its Minneapolis plant in 1931, later was transferred to the Brown division at Philadelphia, then named industrial manager in charge of Brown Instrument sales at Indianapolis, Ind., and for the past three years he has been at Cleveland, Ohio.

Three new vice presidents, namely, William C. Johnson, James M. White and William A. Roberts, have been announced by the Allis-Chalmers Mfg. Co. Mr. Johnson, who has been general sales manager, came to Allis-Chalmers in 1924, serving first in various district offices, later as a sales manager, then took charge of general sales in 1942, succeeding Mr. Geist, who became president. Mr. White came to Allis-Chalmers in 1929 and in 1941 became assistant general works manager, then works manager in 1942. Mr. Roberts joined the company as a salesman after varied experience as a road contractor and salesman and progressed until in 1941 he succeeded the late Harry C. Merritt as manager of the tractor division.

Alexander M. Hamilton has been appointed vice president, Foreign Sales of American Locomotive Co., effective April 1, 1944, according to recent announcement. Between World War I and World War II Mr. Hamilton held various foreign sales positions with the company, serving as European representative with headquarters in Paris after the Armistice until 1921. He is presently executive vice president of Montreal Locomotive Works, Ltd., Canadian subsidiary of American Locomotive Co.

Dr. V. N. Krivobok, former Professor of Metallurgy at the Carnegie Institute of Technology for many years, has become associated with the Development and Research Division of The International Nickel Co. at New York. Dr. Krivobok's services will be utilized mainly in the develop-

FREE STEAM IS WHERE YOU FIND IT

FREE steam, like gold, has to be prospected for. Some prospectors that get around the world have found it at geysers and fumaroles. One notable example of Mother Earth's steam plants is that pictured above in the Norris Geyser Basin, Yellowstone National Park, where huge quantities of steam go to waste every day. Other "prospectors" in getting around their plants have found their "free steam" in the savings made by installing steam plants of higher efficiency and lower upkeep. Cleaver-Brooks oil-fired Steam Generators have a guaranteed thermal efficiency of over 80%, and ask for a bare minimum of attention and maintenance.

The principal factor in low cost per pound of steam delivered by Cleaver-Brooks Steam Generators is their four pass down draft design which gets every possible B. T. U. out of the fuel oil before releasing the combustion gases. They are delivered in compact, self-contained units easily installed and requiring very little maintenance attention. They are clean operating—no smoke, soot, or dirt—an important factor in many industrial and commercial plants.

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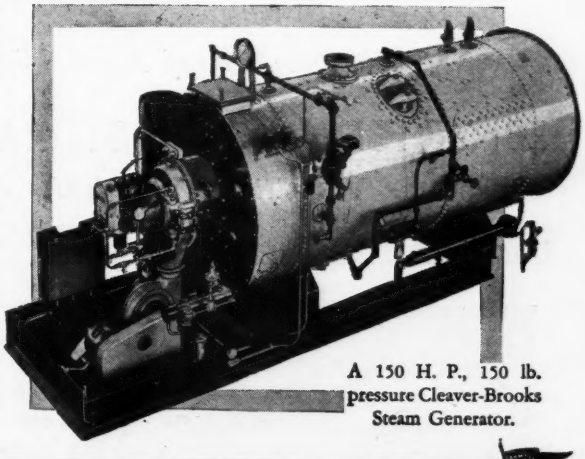
5136 N. 33rd Street **Milwaukee 9, Wisconsin**

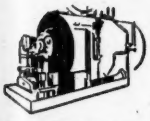
Send for our instant Steam Cost Calculator for figuring steam costs using coal or oil fuel. Yours for the asking.



A 150 H. P., 150 lb. pressure Cleaver-Brooks Steam Generator.

Cleaver-Brooks
STEAM GENERATORS

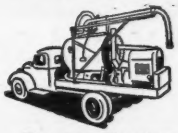
CLEAVER-BROOKS PRODUCTS INCLUDE:



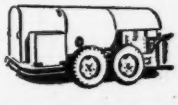
Steam Generators

Food Processing Equipment

Tank Car Heaters



Bituminous Boosters



Special Military Equipment

EQUIPMENT FOR SALE

SEYMOUR, INDIANA PLANT

2—78 in. x 18 ft HRT Brownell Boilers Steel Suspended Strap Butt Joint Quadruple riveted ASME Code.

1—50 ton Vogt absorption equipment including three cylinder horizontal exhaust steam Generator with Vertical analyzer.

Fly wheel type Ammonia Pump with regulator, 4 stands 3 in. x 2 in. Rectifier 6 pipes high x 20 ft. long.

Vertical shell absorber 72 in. dia x 14 ft high with 570—2 in. x 12 ft tubes.

1—A Cylinder Exhaust Steam Generator 18 ft long with analyzer.

2 stands 3½ in. x 2½ in. Double Pipe Exchanger 18 ft long with 20 pipes high.

1 continuous welded pipe condenser 1¼-in. pipe 25 pipes high x 100 ft long.

1—13 in. x 12 in. Left Hand Skinner Engine direct connected to 62.5 kw, 3 phase, 220 v Generator with belted exciter and switch board.

1—35 ton two cylinder Vertical compressor 12 in. x 32 in. steam driven by Vertical Corliss center crank engine.

4 stands 1¼ in. x 2 in. Double Pipe weak liquor cooler 12 pipes high x 16 ft long.

1—100 ton Carbondale Ammonia Generator 4 ft dia x 18 ft long with 22—2 in. pipes 18 ft long.

2 stands Carbondale 2 in. x 3 in. Double Pipe heat exchanger 18 ft long x 14 pipes high.

1—8 in. x 24 in. A. D. Cook Deep Well working head for motor drive.

3 stands 2 in. x 3 in. York Double Pipe cooler 12 pipes high x 16 ft long.

Several stands 1¼ in. x 2 in. Double Pipe coolers 12 pipes high x 18 ft long.

1—Vogt Multitube heat exchanger 8 in. x 18 ft with 7—2-in. tubes 18 ft long.

2—5 kva transformers 220 to 110 v ac single phase.

VINCENNES, INDIANA PLANT

1—42-in. class No. 6 single effect evaporator and condenser 40 tons per hr complete with Size 13 Detroit steam trap with valves, fittings, and connections.—Built by Zarambe Co., Buffalo, N. Y.

1—continuous coil York atmospheric ammonia condenser

5—stands 21 ft long 55 pipes high—1¼-in. pipe, and

7—stands 21 ft long 50 pipes high—1¼-in. pipe.

1—50 ton Vogt absorption equipment including 2 Vogt triple cylinder horizontal exhaust Steam Generators with Vertical analyzers. Vogt fly wheel pump with regulator, 2 stands 2 in. x 3 in. Exchanger 16 ph x 18 ft long.

1—60-in. Vertical Shell and Tube Absorber 12 ft 8 in. high.

1—58 in. x 12 ft Vertical Water Cooling Tank.

1—Rectifier, 2 stands 2 in. x 3 in. x 6 ph x 18 ft long.

6—stands 1½ in. x 2½ in. D. P. Ammonia Condenser 12 ph x 18 ft long.

2—stands weak liquor cooler 1½ in. x 2½ in. x 12 ph x 18 ft long.

2—stands weak liquor cooler 1½ in. x 2½ in. x 12 ph x 18 ft long.

2—66 in. x 18 in. Vogt HRT Boilers with full flush cast iron fronts.

CARMI, ILLINOIS PLANT

1—164 hp Erie City two Drum Boiler and setting.

1—36 in. dia x 60 ft steel stack.

Ready for inspection and prompt delivery.

EBNER ICE and COLD STORAGE CO.

VINCENNES, INDIANA

Cuts your gasket costs in half

The most remarkable tool ever invented

Write for booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere — *Mamaroneck, N. Y.*

ment of markets for alloy and stainless steels and to assist steel manufacturers in expanding markets for their postwar products.

Frank M. Blum has been appointed manager of the P & H Crane Sales Division, Harnischfeger Corp., Milwaukee, to succeed Ben Van Horn who, after 47 years' continued association with the company, has retired. Mr. Blum joined Harnischfeger in 1929 to take over the laying-out and designing of motors, brakes and, mainly, the controls for this line of all-electric heavy-duty hoists since which time he has served as chief draftsman of the Electrical Division, and subsequently, chief engineer of the Electrical Application Division.

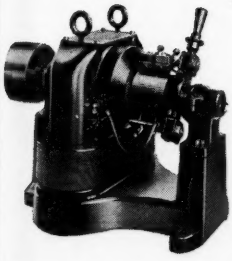
The B. F. Goodrich Co., Akron, Ohio, has announced that John D. Beebe has been named manager of a new department, Rubber Suspension Sales. The new department will have charge of sales of the company's Torsilastic rubber springs and its line of Vibro-Insulators, made of rubber and metal primarily for the elimination of vibration, rubber parts for street cars and devices for sound dampening. Charles W. Staacke has resumed his duties as belting sales engineer for The B. F. Goodrich Co. after many months on special war assignments as a civilian specialist on rubber problems.

The Sullivan Machinery Co., Michigan City, Ind., has announced the election of J. A. Drain, Jr., to the position of vice president in charge of Product Engineering, Research and Development. Mr. Drain was formerly assistant to the president, and prior to joining the Sullivan Co. was president of the Stefco Steel Co. Another selection by the company is that of O. J. Neslage as vice president in charge of sales in the United States and Mexico. Mr. Neslage during the past year was general sales manager and prior to that served as branch office manager in various Sullivan district offices in the mining, oil, construction, and industrial territories of the United States and Mexico.

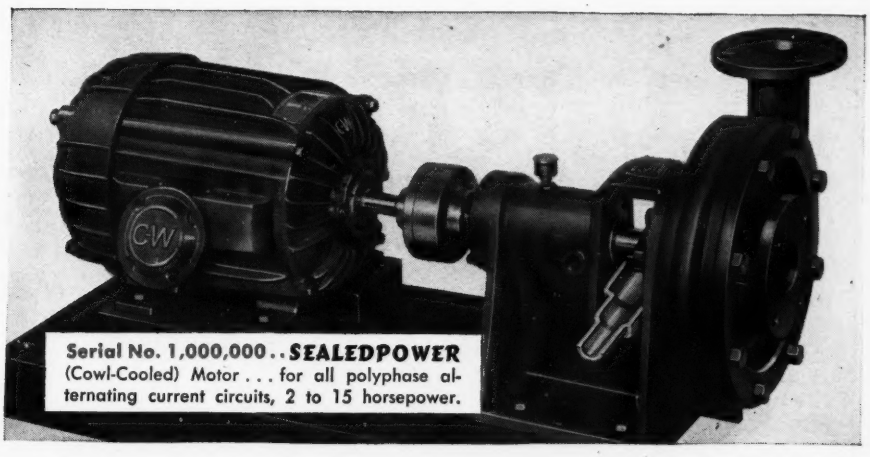
John Avery has been appointed manager of the Allis-Chalmers blower and compressor department to succeed G. L. Kollberg, who is retiring after 47 years of service with Allis-Chalmers but will continue with the company as consultant and advisor on the engineering matters with which he has been intimately associated for so long. Mr. Avery has been assistant manager of the blower and compressor department since 1935.

Wallace Johnson was recently appointed general sales manager of the Joshua Hendy Iron Works at Sunnyvale, Calif. He comes to his new post well qualified to direct the sales of this western manufacturer of prime movers as following graduation from California Institute of Technology in mechanical engineering he has had several years of experience as sales engineer in many fields.

Clarence F. Jensky has been appointed special representative of the Joshua Hendy Iron Works turbine design, construction and manufacturing; and will make his headquarters at the Washington, D. C., office. Jensky has been with the Hendy plant for the past nine months. Mr. Jensky has been a leading figure in Hendy turbine development and design up to this time.



Serial No. 1 . . . Crocker-Wheeler Motor, built in 1888.

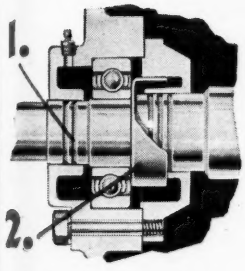


Serial No. 1,000,000 . . **SEALEDPOWER** (Cowl-Cooled) Motor . . . for all polyphase alternating current circuits, 2 to 15 horsepower.

SEALEDPOWER

Industry's Most Trouble-Free Motor

PRODUCED BY CROCKER-WHEELER'S 56 YEARS OF EXPERIENCE



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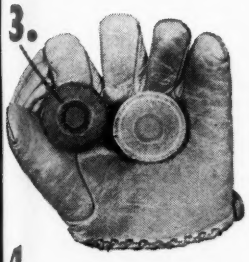

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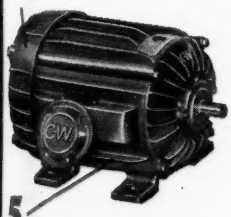


5.

CROCKER-WHEELER FEATURES:

1. Patented "Groovseal"—no greasing needed for at least a year. Grooves minimize grease loss. This seal makes bearing maintenance expense negligible. It permits use of softer grease, for better lubrication and longer bearing life. Airtight seal prevents dust or other foreign matter from entering bearings.

2. Crocker-Wheeler's exclusive De-Sludging Impeller. Automatically desludges . . . churns and distributes grease to bearings when motor is started.

3. Vacuum Impregnation—standard on *all* Crocker-Wheeler motors. Seals out foreign matter and moisture from each individual coil . . . fills all interstices, making windings a homogeneous mass . . . reduces hot-spot temperature and lengthens insulation life. Adherence of varnish prevents vibration of wires either inside or outside of slot. (Photograph shows cross sections of baseballs, (left) after vacuum impregnation and (right) before vacuum impregnation. Note penetration of varnish to center of tightly-wound ball, making it a moisture-proof, homogeneous mass.)

SEALEDPOWER FEATURES:

4. Totally Enclosed Cowl-Cooled Construction resists corrosion. Protects against acid or alkali fumes, splashing or dripping liquids, air-borne moisture, steam, corrosive gases, conducting dusts, metallic chips, etc.

5. Fin Type Construction for non-clog ventilation and easy cleaning.

WRITE FOR LITERATURE ON THE **SEALEDPOWER** MOTOR, WHICH IS WINNING THE PREFERENCE OF MACHINERY MANUFACTURERS AS WELL AS OF MOTOR USERS. OR CALL OUR NEAREST OFFICE.

CROCKER-WHEELER Motors-Generators

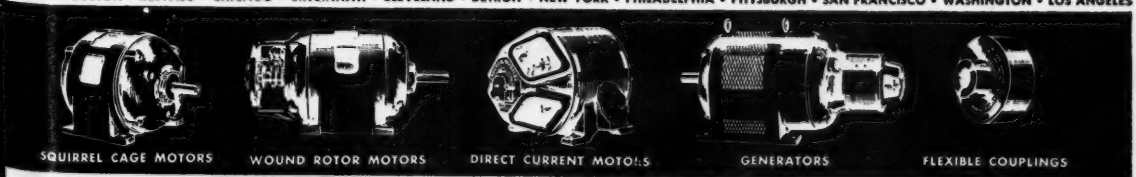
JOSHUA HENDY IRON WORKS

CROCKER-WHEELER DIVISION

ESTABLISHED 1856

AMPERE, NEW JERSEY

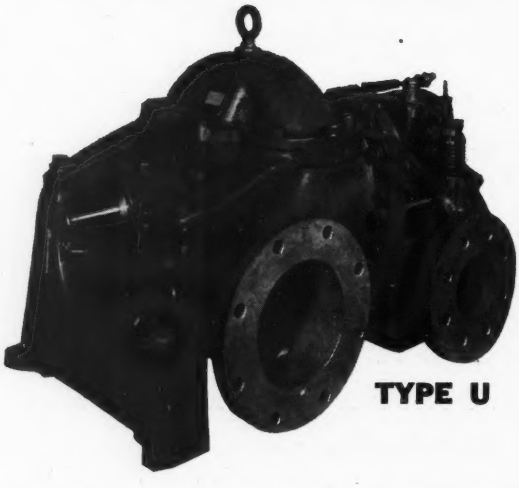
Branch Offices: BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • NEW YORK • PHILADELPHIA • PITTSBURGH • SAN FRANCISCO • WASHINGTON • LOS ANGELES



SQUIRREL CAGE MOTORS | WOUND ROTOR MOTORS | DIRECT CURRENT MOTORS | GENERATORS | FLEXIBLE COUPLINGS

MURRAY

SINGLE STAGE TURBINES FOR MECHANICAL DRIVE



TYPE U

CENTER-LINE support and ample sized bearing reservoir shown by this three-quarter view are standard on Murray Type U Turbines, built in a variety of wheel sizes, with two-row and three-row impulse wheels, with all materials suitable for the operating conditions. May be obtained with any type of governor for either constant or variable speed. Ask for Bulletin T-118.

Other Murray Products

Turbine Generator Sets up to 2500 KW rating

Multi-stage Type UV Turbines • High speed Reduction Gears

Vertical Turbines • Steam Boilers

MURRAY IRON WORKS COMPANY

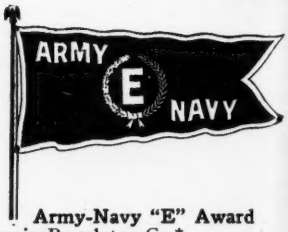
BURLINGTON, IOWA

Builders of Steam Power Equipment for Three Quarters of a Century

BACK THE ATTACK WITH WAR BONDS

F. H. Herndon has been appointed manager of the Link-Belt Co.'s Coal Stoker Division, in full charge of its activities and personnel, with headquarters at the Caldwell plant in Chicago. Mr. Herndon has been assistant manager for the last 10 years. Announcement is also made that K. C. Ellsworth, heretofore eastern stoker division manager at New York, has been appointed sales manager of the stoker division, with headquarters at the Caldwell plant.

MANUFACTURERS' NEWS



Army-Navy "E" Award

Askania Regulator Co.*
Chicago, Ill.
Briggs Clarifier Co.*
Washington, D. C.
Combustion Engineering Co.
Savannah, Ga., Plant
Cooper-Bessemer Corp.
Grove City, Pa.
Link-Belt Co.
San Francisco Plant
Ohio Injector Co.*
Wadsworth, Ohio
Sterling Engine Co.*
Buffalo, N. Y.

Maritime Commission "M" Award

Combustion Engineering Co.
Heine Boiler Div., St. Louis, Mo.
Hedges-Walsh-Weidner Div., Chattanooga*

National Security Award

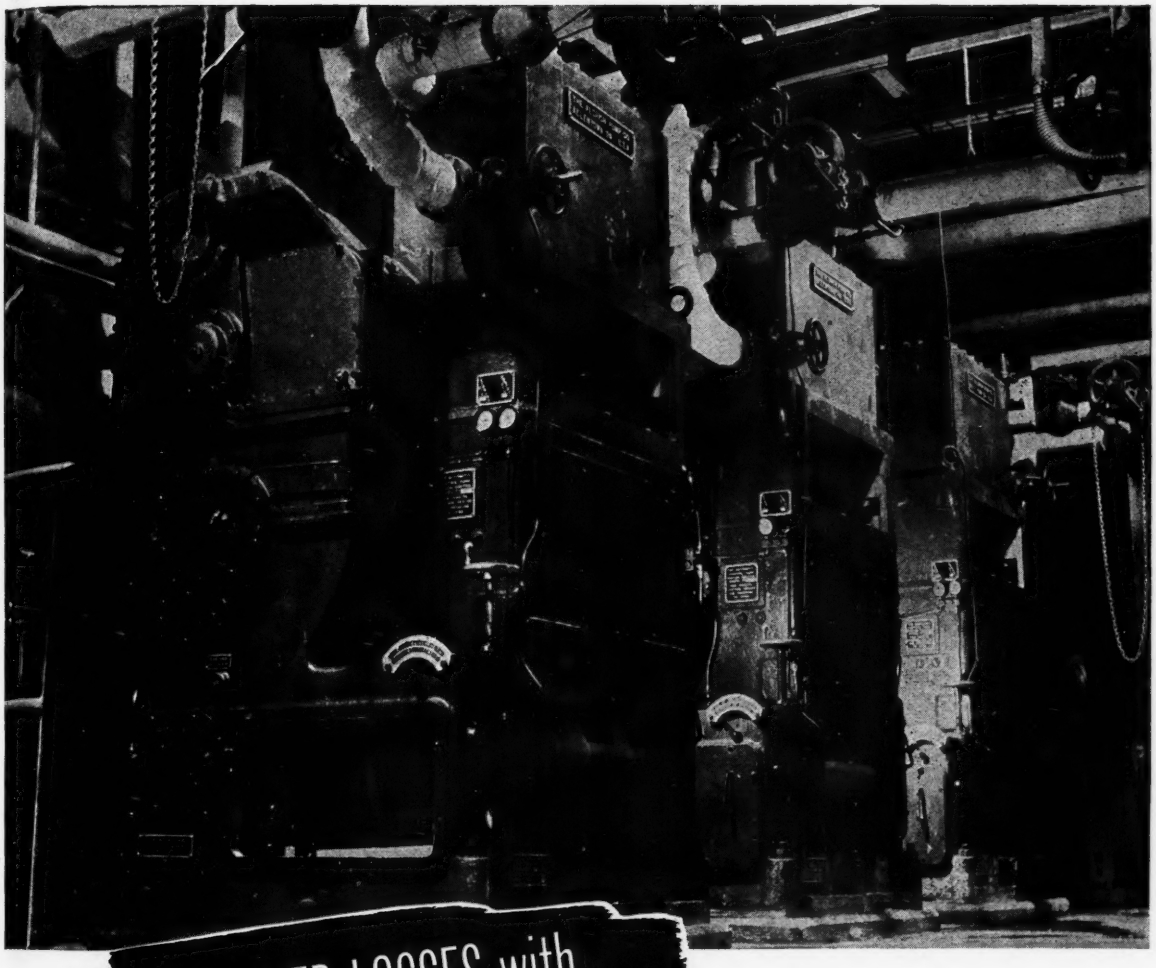
Westinghouse Electric and Mfg. Co.
Nuttall Works

* Star added for sustained high achievement in production of war equipment.

The U. S. Machine Corp. of Lebanon, Ind., has announced appointment of Electrol Oil Burner Corp. of Seattle, Wash., as distributor of Winkler Stokers for certain territories in the states of Oregon and Washington west of the Cascade Mountains, and for British Columbia and Alaska. Heading the Electrol firm is Robert Denny Watt, president and son of its founder, the late Paul H. Watt.

Builders-Providence, Inc., Proportioneers, Inc., and Omega Machine Co. moved their combined offices to 807 Hardt Bldg., 1649 N. Broad St., Philadelphia 22, Pa., where they will conduct their activities of complete engineering and sales service on metering, controlling and chemical feeding.

Stockholders of the Detroit Edison Co. at the annual meeting reelected the following three directors to succeed themselves for three-year terms: Alfred C. Marshall, president of the company, James W. Parker, its vice president and general manager, and James F. Fogarty. President Marshall stated that more than 84 per cent of the stock was represented at the meeting and was voted favorably, a higher percentage of representation than at any time in recent years. All of the present officers of the company were reelected or reappointed with but two changes. James H. Lobban was appointed gen-



CUT POWER LOSSES with . . .

. . . ALDRICH-GROFF CONTROLLABLE CAPACITY "POWR-SAVR" PUMPS

Aldrich-Groff pumps on unit feed systems eliminate pressure and power losses common to throttling-type feed regulating valves and offer advantages of feed system simplicity, efficiency and mechanical reliability for small and medium installations at medium and high steam pressures.

Equally important overall power savings are effected by Aldrich-Groff pumps on de-superheater feed service in connection with high pressure topping units for power stations of any size.

The three Aldrich-Groff 3¼" x 0 to 6" variable stroke vertical triplex pumps shown above are in service in a mid-western central station employing the unit system for main boiler feed. Two are driven by constant speed motors and the third by a constant speed steam turbine. Power consumption is almost directly proportional to pump delivery.

The 6" stroke — 3¼" plunger pump is a 100 HP unit and when operating at maximum speed can deliver 70,000 pounds of feed water per hour against 1025 pounds boiler pressure.

WRITE TODAY . . .

for bulletins and material giving full details, sizes and ratings of Aldrich-Groff Pumps.

THE ALDRICH PUMP CO. ALLENTOWN • PENNA.

Representatives: Birmingham • Bolivar, N. Y. • Boston • Chicago • Cincinnati • Cleveland • Denver • Detroit • Duluth • Houston • Los Angeles • Pittsburgh • Portland, Ore. • St. Louis • San Francisco • Seattle • Tulsa

Don't risk damage to tube cleaners and hose

Kinking tube cleaner hose to shut off air is poor practice at any time, especially now, when hose is a critical material. Besides ruining the hose, small hose particles may peel off and clog the motor.

Why risk damage to tube cleaners and hose by kinking the hose to control the air. A Roto Operating Air Valve attached to the tube cleaner motor, enables the operator to control the air safely, entirely by himself. This inexpensive valve speeds up tube cleaning and releases a helper for other work. Our complete line of modern, efficient tube cleaners will meet practically every requirement. Write.

The ROTO Company

145 Sussex Ave., Newark, N. J.

A DIVISION OF ELLIOTT COMPANY

What This Symbol Means To You

Banded together in The Associated Business Papers is a group of 133 dominant business publications which are independently operated, editorially unfettered, ethically administered. Power Plant Engineering is proud of its membership in ABP, and of the high publishing standards which help to make it an accepted authority in the field of power generation, transmission and utilization.

eral accountant and Thomas E. Hurns, assistant general accountant. Sullivan and Cromwell were appointed general counsel of the company and the firm of Hull, Brown and Fisher was appointed counsel in Michigan to serve for the coming year.

At a recent meeting of the Board of Directors of the C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., A. F. Rucks, who has been associated with the company for over thirty years, was elected president and general manager. He succeeds the late C. D. Waters. At the same meeting, J. T. Kottcamp, vice president of the Johns Manville Products Corp., was elected to the Board of Directors of the company.

Cochrane Corp. of Philadelphia announces the acquisition of exclusive sales rights to the line of rotameters manufactured and hitherto sold by Rotameters, Inc., of Jenkintown, Pa. According to P. S. Lyon, president of the Cochrane Corp., this is a logical addition to the Cochrane meter line, as Cochrane has manufactured and sold a recording area type meter for the past seven years and the addition of the rotameter, or indicating type of area meter, rounds out the line.

No change will be made in the personnel of the two companies, William C. Bennett being manager of Cochrane's appliance division, with W. W. Tomes in charge of sales and William Melas in charge of engineering, while for Rotameters, Inc., J. B. Vandegrift, recently appointed general manager, is associated with Alfred Elsasser, technical director, Robert C. Wolf, chief engineer, Reynold Wilson and Joseph Madden, glass technologists, and Howard Forepaugh, office manager, several of whom helped pioneer the development of the American rotameter into a successful measuring device with interchangeable precision-bore tubes. The rotameter will be sold by Cochrane flow meter representatives.

Foster D. Snell, Inc., 305 Washington St., Brooklyn 1, N. Y., has purchased National Calibration Service of Brooklyn, N. Y., which will be operated as a separate department by the Snell organization. The principal business of National Calibration Service was verification of vertical compression and tensile testing machines and included in its assets was a set of Whittemore-Petrenko rings as well as other equipment for the purpose.

The Baldwin Locomotive Works has opened a district sales office at 2929 Nineteenth St., San Francisco, in charge of Ray S. Quick, who also is general manager of The Pelton Water Wheel Co. The new office will handle sales of all divisions of the company. In addition to covering the Pacific Coast district, the San Francisco office will direct sales of Baldwin products in the territories of Alaska and Hawaii.

H. G. Mueller and Associates have announced the opening of offices at 649 Hilltop Road, Erie, Pa., to provide a new engineering service to manufacturers for product engineering including: new ideas and designs, improvement of present products, engineering on Government contracts, research and inventions, drafting and shop drawing service, investigations, trouble analysis, test reports and sales. Mr. Mueller for many years was connected with the engineering department of Skinner Engine Co., of Erie, and more recently with Ajax Iron Works, of Corry, Pa.

HOW MUCH LESS PAPER CAN YOU USE IN YOUR PLANT?

That's a mighty important question. Paper stocks are seriously low this year, and every time another shipload of paper-wrapped war supplies leaves an American port, the problem gets tougher • The voluntary cuts, the simple economies you have put into operation up to now, won't be half enough in 1944 • The only answer is honest, convincing *paper-pinching* by every one who uses paper • Organize a Paper Conservation Committee in your company. Pick only the best men for this job, and give them a green light, so that they can work effectively • From envelopes to heavy cartons, have this Committee see to it that functional packaging is the order of the day—every day • In the panel are suggested many ways your plant can use less paper. But you know your own business best! Go to it *NOW!*

Use Less Paper Because

Multiwall paper bags are used extensively in shipping flour and dehydrated foods.

All openings and exposed surfaces of tanks are sealed with paper for shipping.

Submachine guns are not only paper-wrapped but boxed in paper board. Shell grommets, bomb rings and practice bomb fins are made of paper to save needed steel.

Gas-mask canisters and hand-grenade containers are made of paper.

Paper is used in camouflage strips and netting and parachutes.

All Army clothing and equipment are shipped in waterproof paper wrappers.

Use Less Paper These Ways

Condense letters and memoranda by (a) keeping margins as narrow as possible; (b) sticking to single-space forms; (c) using reverse side of incoming letters as first carbon copy of replies; (d) using reverse side of second sheets for carbon copies; (e) using both sides of all mimeographed sheets.

Check carefully to determine whether your shipping container exceeds the requirements of Rule 41 of "consolidated freight classification requirements."

Eliminate individual cartons in every practical instance.

When individual cartons are indispensable, pack in bulk whenever possible.

Control disbursement of paper supplies to employees so that excessive quantities do not accumulate in desks and departmental supply closets.

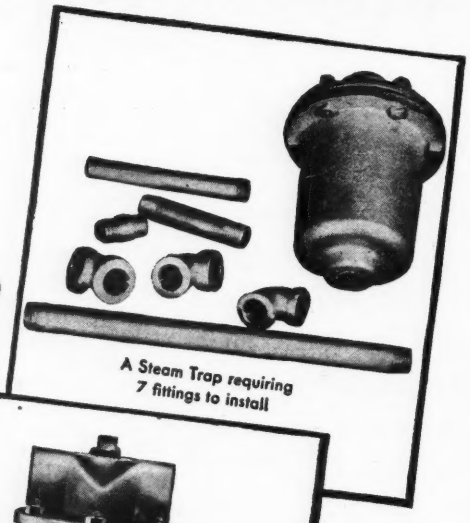
This advertisement prepared under the auspices of the War Advertising Council in co-operation with the Office of War Information and the War Production Board.

LET'S ALL USE LESS PAPER

Space for this advertisement contributed by POWER PLANT ENGINEERING.

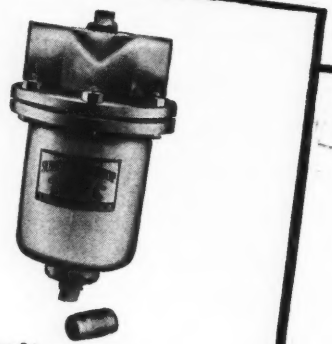
IT'S YOUR MONEY, MISTER

AND YOU CAN SPEND IT FOR THIS →



A Steam Trap requiring 7 fittings to install

OR THIS ↘



A Super-Silvertop Steam Trap Requiring one fitting to install

When considering the purchase of Steam Traps, it's your money that is being spent. You can select a trap requiring many fittings and the extra time to install them . . . or you can buy a Super-Silvertop Steam Trap that is installed straight-in-line or as an elbow requiring one fitting (in some cases two), and necessitating approximately an hour's less labor for each installation.

Which will it be? If there is a question of doubt in your mind, send for the book, "How to Choose a Steam Trap." It gives you complete, concise and detailed information on a Steam Trap to fit your particular job.

THE V. D. ANDERSON COMPANY
1939 West 96th Street • Cleveland 2, Ohio

SUPER-SILVERTOP STEAM TRAPS

Reliable Buying Bulletins

In these pages you will find advertisements of firms that make every type of machinery and equipment for generating, distributing and utilizing power. Their messages constantly record latest progress in power plant equipment. They tell you who makes it, who stands behind it. Consider their advertisements as convenient and reliable buying bulletins.

Announcement is made by Link-Belt Co., Pacific Division, that a sales office and warehouse has been opened in Spokane, Wash., with Homer A. Garland in charge. The new address is South 151 Lincoln St. A representative line of power transmission, elevating and conveying equipment will be carried in stock. Eastern Washington, northern Idaho and a western portion of Montana will be served from the new office.

W. Gibson Carey, Jr., president of the Yale & Towne Manufacturing Co., Chrysler Building, New York, has announced that the purchase of the scale business of the Kron Co. of Bridgeport, Conn., has been consummated.

The Kron Co. has designed, manufactured and sold industrial scale equipment for more than a quarter of a century, and no changes in the line are contemplated, except for such natural developments which grow out of industry's needs. The scale line now includes a comprehensive range of bench, platform, abattoir, hopper, crane and hoist types and capacities for weighing and counting parts or products, batching concrete, asphalt and numerous other materials in their dry state, for measuring flow or consumption of fuel oil and other liquids, testing tensile strength of various products, the pull of electric and fuel motors and so on. Certain models are equipped with electronic devices for special uses, or a register which prints a weight ticket or records on tape.

The facilities and personnel of the Kron Co. will be maintained in Bridgeport as heretofore, together with the sales and service organization, but all will be under the general direction of the Philadelphia Division of Yale & Towne Manufacturing Co.

NEWS FROM THE FIELD

Western Massachusetts Elect. Co. Personnel Change

JAMES P. MCKEARIN, chief engineer for Western Massachusetts Electric Co. retired on April 1, 1944. Mr. McKearin was formerly employed by the General Electric Co. and resigned as assistant district engineer of their Boston office in 1917 to accept the position of electrical engineer of the United Electric Light Co. at Springfield.

When the United Electric Light Co. joined the Western Massachusetts Companies' group in 1927, Mr. McKearin was appointed electrical engineer for all of the constituent companies in that group and was appointed chief engineer in 1936.

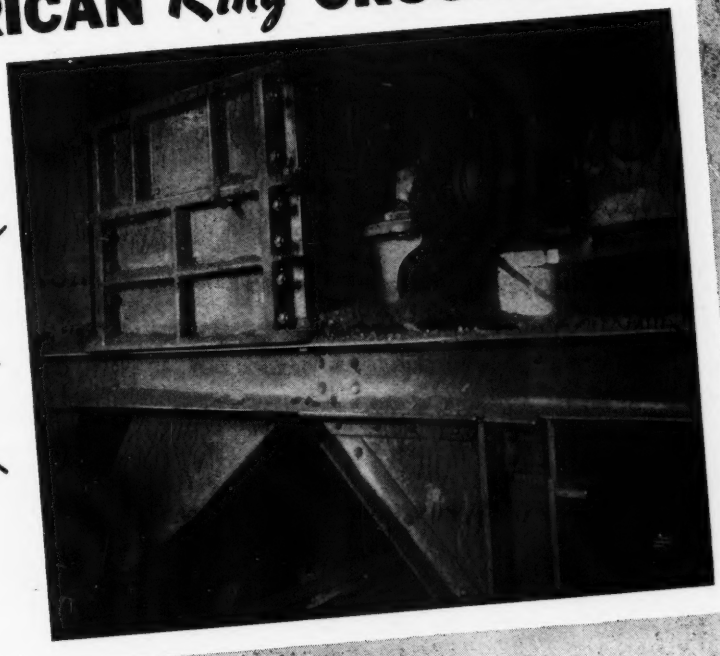
Mr. McKearin was responsible for many additions and improvements to the company's electrical system. Some of the major items were the building of the 66,000 and 115,000 v Montague Substation at Montague City, changes in the transmission system from 66,000 to 115,000 v, the design and building of the 115,000 v East Springfield Substation in East Springfield, the medium voltage network system in Pittsfield, the low

Using AMERICAN *Ring* CRUSHERS

busy chemical plant

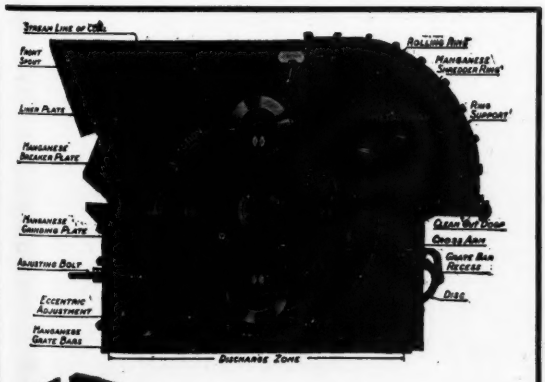
CRUSHES COAL

at 1¢ per ton



Find Out What They Can Save You . .

Coal crushing to proper combustion size at a total cost of *less than a penny per ton, including maintenance, power, labor, depreciation and interest on investment,* is an everyday performance for the AMERICAN Ring Crusher.



Above: Cross-sectional view of American Ring Crusher. Left: Patent shredder rings split coal in uniform size instead of crushing it —a patented "American" feature.

It is being done, for example, at the busy South Charleston, W. Va., plant of Westvaco Chlorine Products Co., whose crusher is pictured above. It is being done also in the boiler room of a packing plant in Iowa, a central station in Illinois and many other classes of plants.

Coal entering the AMERICAN Ring Crusher from the top, falls on and is struck by rings in suspension. This action of the rings, shattering and distributing coal before it reaches the breaker and grinding plates, is the "inside story" of American Ring Crusher economy. See diagram at left.

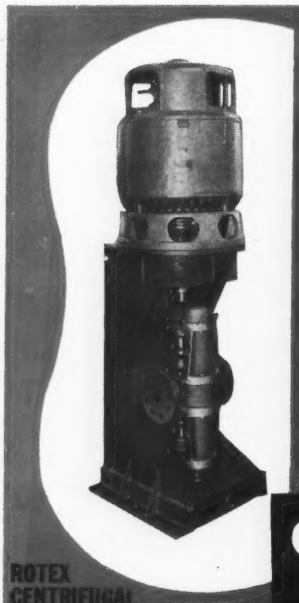
For Stoker or Pulverized Coal Burning

The use of AMERICAN Ring Crushers in power plants also promotes operating efficiency through better sizing of coal for either stoker or pulverized coal burning. Hundreds of installations have shown that this better sizing cuts fuel costs from 2½ to 8%.

Find out what AMERICAN Ring Crushers can save in your plant. They are of heavy steel construction for long life, are equipped with anti-friction bearings for low power consumption. Complete performance information, together with list of users in plants like yours, will be sent on request.

AMERICAN PULVERIZER COMPANY
1429 Macklind Avenue
St. Louis 10, Missouri

ORIGINATORS AND MANUFACTURERS OF RING-CRUSHERS AND PULVERIZERS



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PULSELESS DISCHARGE

means . . .

LONGER LIFE
LESS MAINTENANCE
STEADY FLOW

ROTEX
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SCREW
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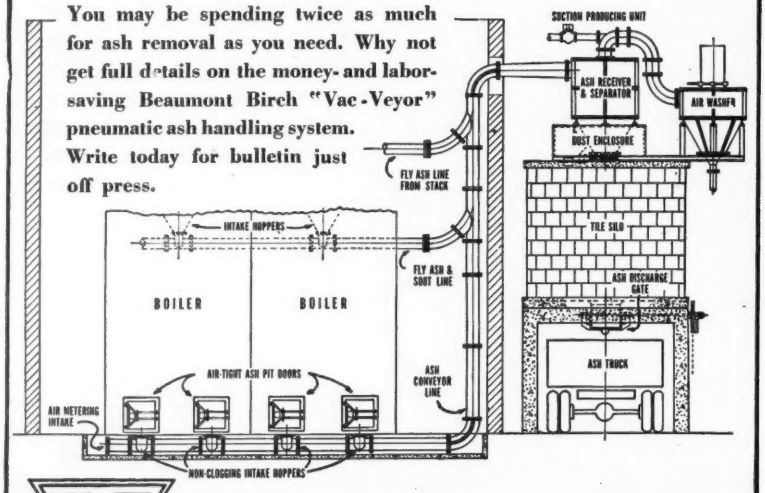
HOW MUCH ARE YOU PAYING TO HANDLE ASHES?

You may be spending twice as much for ash removal as you need. Why not get full details on the money- and labor-saving Beaumont Birch "Vac-Veyor" pneumatic ash handling system. Write today for bulletin just off press.



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1505 RACE STREET PHILADELPHIA, PA.

DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

voltage network system in Springfield, and the installation of the carrier current relay setup on the transmission system.

Mr. McKearin is a Fellow of the American Institute of Electrical Engineers, a member of the Engineering Society of Western Massachusetts and the Springfield Lodge of Elks. He plans to continue to maintain his residence at 81 Lyndale Street, Springfield.

John W. Bennett, who has been assistant chief engineer of Western Massachusetts Electric Co., was appointed chief engineer to succeed Mr. McKearin.

Mr. Bennett was born in Wright County, Minnesota, and attended the University of Minnesota. Previous to joining the Western Massachusetts Companies' organization in April, 1930, as distribution engineer, he was head of the Engineering Department of the Eastern New Jersey Power Company. He was chairman of the Springfield Section of the American Institute of Electrical Engineers in 1934-5, and president of the Engineering Society of Western Massachusetts in 1939-40.

Dr. Willis R. Whitney Receives Honorary Membership in Electrochemical Society

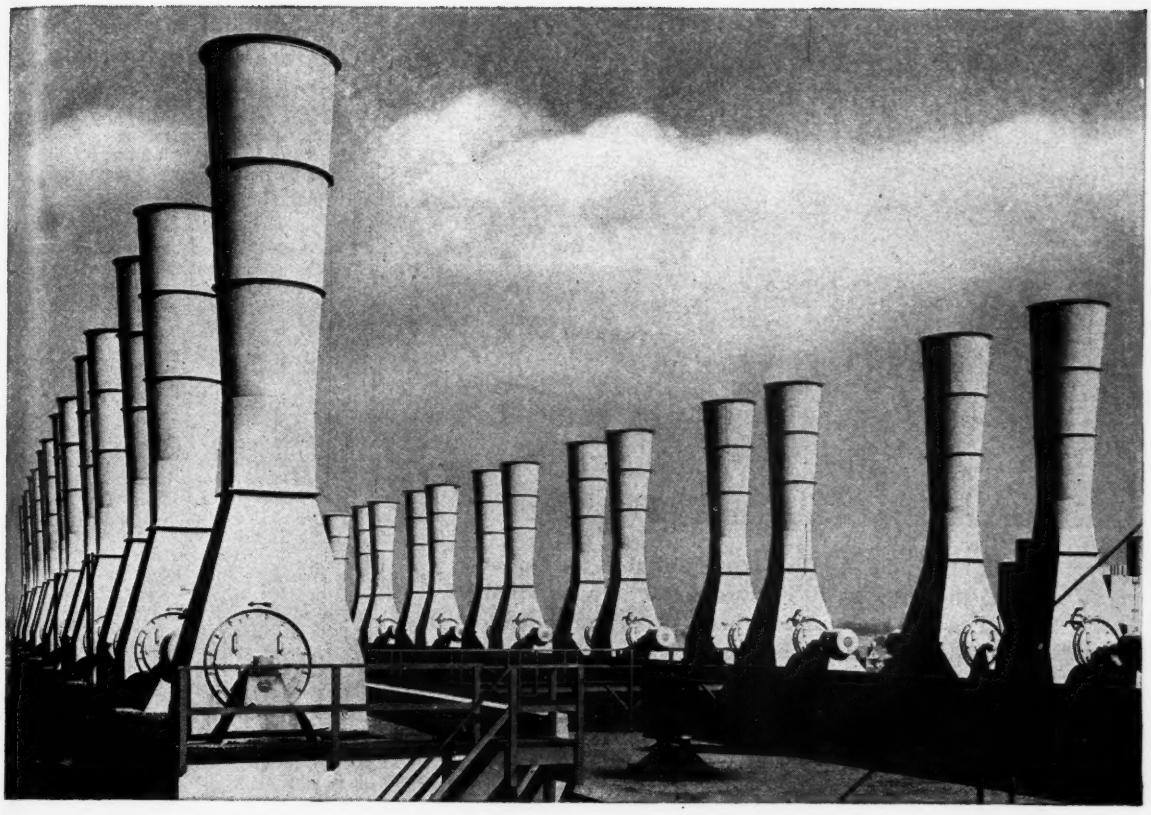
DR. WILLIS R. WHITNEY, honorary vice president of the General Electric Co. and first director of its Research Laboratory, has been made an honorary member of the Electrochemical Society. A charter member of the organization and its president in 1912, Dr. Whitney was awarded the certificate of honorary membership from the Society's president, Dr. Robert M. Burns, on April 14, during the organization's meeting in Milwaukee.

National Association of Power Engineers to Meet in St. Louis

PLANS ARE NOW BEING MADE for the annual meeting of the National Association of Power Engineers to be held in St. Louis next August 22 to 25 at Hotel Jefferson. As is customary, the National Power Show will be held in conjunction with the meeting. Invitations to all recognized engineering societies have been extended and an interesting program of nationally known speakers is being arranged. The general chairman of the local convention committee is F. C. Laufketter and J. A. Whitmer, 6020 S. Kingshighway, St. Louis 9, Mo., as chairman of the publicity committee, is in position to answer inquiries regarding the convention.

Dates Announced for Annual Meeting of Smoke Prevention Association

THE SMOKE PREVENTION ASSOCIATION OF AMERICA, through its secretary, Frank A. Chambers, has announced that the annual meeting of the Association will be held June 6 to 9 inclusive at the Hotel Statler in Detroit, Mich. All phases of smoke abatement will be covered at the meeting with special emphasis on the influence that the enforcement of smoke ordinances has on fuel conservation and how smoke departments throughout the country can cooperate with the National Fuel Efficiency Section of the U. S. Bureau of Mines.



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These Thermix Fan-Stacks are evacuating approximately 2,000,000 cubic feet per minute of dangerous fumes to the atmosphere. That's all we can tell you about them now.

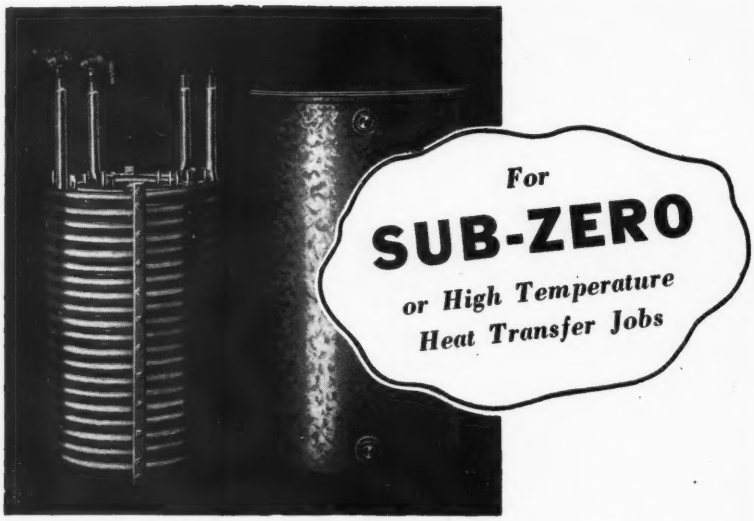
Because Thermix Stacks proved their dependability and efficiency in pre-war work, hundreds of them have already gone into service in war plants. They are doing their part in the gigantic struggle to increase production and to save power, fuel and steel.

Our facilities are devoted entirely to the manufacture of high priority equipment for the war effort.

Catalog No. 109 sent on request.

PRAT-DANIEL CORPORATION, PORT CHESTER, N. Y.

Project Engineers: Thermix Engineering Co., Greenwich, Conn.



Rempe Shell and Coil units are suitable for liquid cooling to as low as 40 degrees below zero or liquid heating to elevated temperatures. They are individually designed for specific capacity requirements. Write for estimates.

REMPE CO.
342 No. Sacramento Blvd., Chicago

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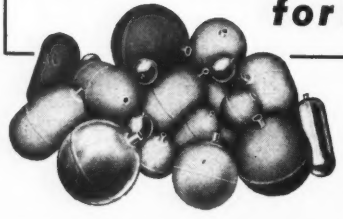
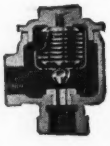
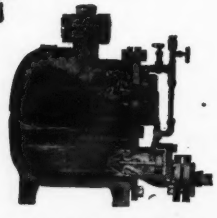
FOR
TRAPS • FLOATS • VALVES
for Every Purpose



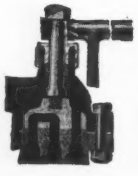


THERMOSTATIC INDUSTRIAL TRAPS—Five types; sizes ¼" to 2"; 2 to 6 times greater valve area; pressures to 225 lbs.

NICHOLSON Steam Traps, Floats, Valves and other control devices are today being put into use by representative firms in every major line of American industry—conclusive proof of their superior features.
FLOATS, above, are made in all shapes and sizes.



PISTON-OPERATED STEAM TRAP—High pressure model with non-wire-drawing discharge valve. For pressures to 650 lbs. . . . one of a variety of modernly designed "operated" traps for many uses.



CYLINDER CONTROL VALVES—2, 3, and 4-way types for single and double-acting cylinders. Pressures to 5,000 lbs. For air, steam, water, oil, etc.

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W. H. NICHOLSON & CO. 160 Oregon St. Wilkes-Barre, Pa.

Fifth Annual Water Conference to Be Held October 30-31

THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA is planning to hold its 5th Annual Water Conference in the William Penn Hotel, Pittsburgh, Pa., on October 30-31. As in the past, H. M. Olson, Chairman of the Water Conference, will have general charge of the entire meeting and all inquiries regarding the arrangments should be addressed to him in care of the Engineers' Society of Western Pennsylvania, William Penn Hotel.

U. S. Bureau of Mines Opens Chicago District Office

A CHICAGO DISTRICT OFFICE of the U. S. Bureau of Mines, in charge of Arlen Z. Jennings, newly appointed district engineer, was opened on April 1, 1944. The address is U. S. Courthouse, Rooms 853-854, Chicago 4, Ill., Telephone: Harrison 4700, Extensions 84 and 193. This is the first office of the Bureau in Chicago. In addition to its functions as a branch office of the Bureau of Mines, the office will co-operate in technological investigations of:

1. Fuels utilization (coal, oil, gas)
2. Handling and storing coal by
   a. Great Lakes coal docks
   b. Mid-West river docks
   c. Industrial plants
3. National Fuel Efficiency Council's program

Mr. Jennings has been instructed to continue for another season the investigation begun two years ago on handling and storing coal on the Great Lakes. He will gladly make available, to all those interested, the information he has gathered on this subject, as well as all other data on fuels prepared by the Bureau for public use.

Research on Coal-Fired Boilers

POSSIBILITIES of coordinating their efforts in research for the improved utilization of bituminous coal were discussed by boiler and radiator manufacturers and members of Bituminous Coal Research, Inc., at a joint conference of the Institute of Boiler and Radiator Manufacturers and the Heating Equipment and Residential Stoker Committee of B.C.R. at Battelle Institute, Columbus, Ohio, March 21.

The meeting was called to determine what information on bituminous coal that would foster their mutual interests could be obtained by B.C.R. for the Institute of Boiler and Radiator Manufacturers. Preliminary plans for the formation of joint research advisory committees were made, and trends in boiler manufacture, boiler performance, hand firing and stoker firing, and methods of testing and rating boilers were discussed.

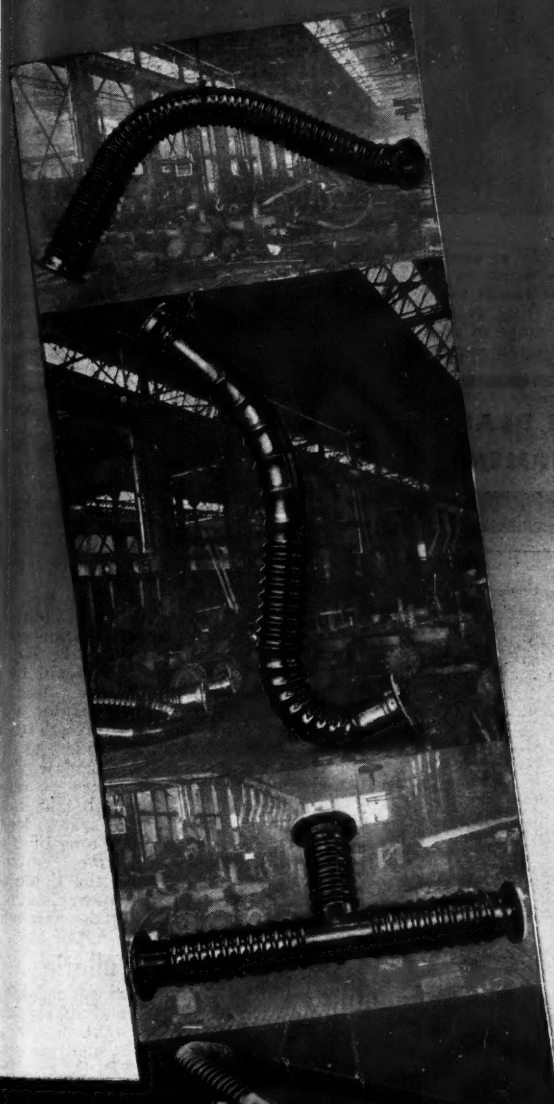
J. F. McIntire, vice-president in charge of research, U. S. Radiator Corp., presided over the conference, and H. N. Eavenson, president of B.C.R., J. E. Tobey, chairman of the B.C.R. Technical Advisory Board, and C. F. Hardy, chairman, B.C.R. committee on Heating Equipment addressed the group. Each cited the need for cooperative effort to improve the utilization of coal in boiler heating equipment.

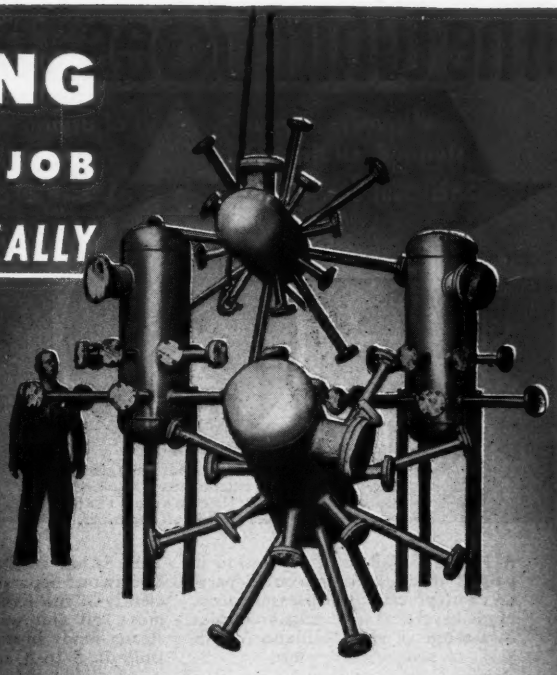
The conferees agreed that conven-

KELLOGG PIPING

IS DESIGNED TO DO A JOB

CORRECTLY and ECONOMICALLY





KELLOGG prefabricated piping systems simplify piping problems because they conserve space—minimize joint stresses—provide safe connections to equipment unable to stand high forces or moments due to expansion—and give flexibility and complete reliability.

Many of America's central stations, process plants and marine power plants have successfully met war time emergency needs because the Kellogg piping was designed and prefabricated to provide sufficient flexibility and reliability.

KELLOGG

"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories. Radial Brick Chimneys.

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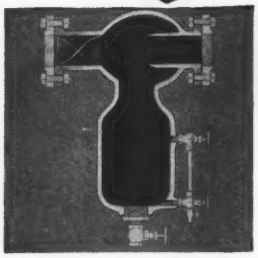
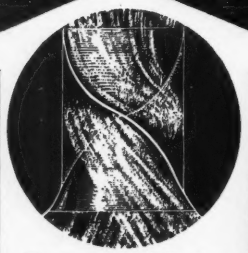
The Whirl Does the Trick

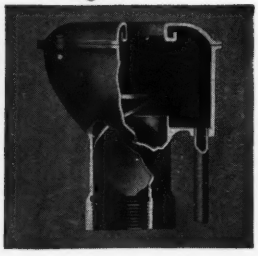
of purifying your steam & oil through Swartwout Separators

of drying exhaust steam through Swartwout Exhaust Heads





The Swartwout Helix gives the entering steam a *positive* whirling motion that throws aside all impurities.



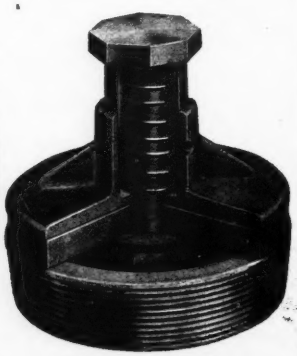
A HIGH DEGREE of separation is gained through Swartwout Separators with practically no pressure drop. Made in vertical and horizontal styles in a range of sizes. Bulletin S-14-B sent upon request.

THE SAME PRINCIPLE as used in Swartwout Separators works as efficiently in the Exhaust Heads to remove oil and water from exhaust steam. Made in wide range of sizes. Bulletin S-16-A sent upon request.

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave. Cleveland 12, Ohio

Can you afford to run racing **STEAM-WASTING PUMPS?**



S-l-o-w 'Em Down With COMBINATION NON-TILT VALVES

If your plant operates two or more reciprocating pumps—Boiler Feed, Vacuum, Condenser, General Service—the chances are that you can save up to 15% in steam and cut maintenance cost at the same time by using COMBINATION Pump Valves. They lift straight, close quickly, prevent racing and hammering, eliminate many pump repair bills. Ask for descriptive bulletin.

They Match the Fine Performance of Combination Silent Check Valves.

COMBINATION PUMP VALVE CO.

846 WIOTA STREET, PHILADELPHIA, PA.

ience of use and smokeless performance were prime requisites of postwar heating equipment. Heating plants for the small home of the future will be designed for 50,000 Btu per hr maximum rating, it was believed. Improved workmanship and the liberal use of insulation in postwar home construction, with consequent saving in fuel, were foreseen.

Hand-fired boilers are expected to meet the needs of the small home owner whose heat requirements are too small to warrant a stoker. The principal problem is the design of fuel and combustion space to provide smokeless combustion and infrequent attention. The question will be explored further in future meetings.

Automatic firing of residential boilers by clinker-type stokers has presented a problem in boilers of small grate dimensions. Discussion of designs of new equipment to permit automatic firing of small boilers was scheduled for another meeting. Larger residential boilers have long been fired successfully with stokers of various types.

Springdale to Add 65,000-kw Unit

APPROVAL to install a 65,000 kw generating unit has been given by the War Production Board to West Penn Power Co. in order to meet the increasing electrical requirements of war industries and communities in Western Pennsylvania, it was announced April 19 by H. L. Mitchell, president.

It is planned to add the new unit to the company's Springdale Power Station on the Allegheny River, 17 miles above Pittsburgh. The additional capacity will increase this station's capability to approximately 300,000 kw and make it one of the largest in Western Pennsylvania.

Springdale Power Station will be enlarged to house the new addition, which will be a unit installation consisting of an 800,000 lb per hr boiler to supply 1250 psi, 925 F steam to a 3600 rpm condensing turbine. The 80 per cent power factor generator will be connected directly through two 40,000 kva, 3-phase transformers to the present 132 kv bus at Springdale. No additional transmission lines or substations will be required to take care of the increased station or system load.

The additional 275,000 tons of coal per year required will come from the present Springdale mine, the tipple of which is adjacent to the power station.

The program calls for the new unit to be in operation in the fall of 1945.

Coal Sampling Bulletin

THE BUREAU OF MINES has published a bulletin showing quantitatively the effect of the variables that determine the final accuracy of the analysis of a sample of coal, Dr. R. R. Sayers, Director of the Bureau, has announced.

This bulletin, presenting information of significance to large fuel producers and to industrial and commercial consumers requiring coal of definite specifications, was prepared by Bertrand A. Landry, consulting fuel engineer at the Bureau's central experiment station in Pittsburgh, Pa. It contains hitherto unpublished data on coal sampling and float-and-sink tests made available from the Pittsburgh Coal Co., Battelle Memorial Institute and the Bureau of Mines.

Variables are of two kinds, the bulletin notes; first, those related to the

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CRYSTOLON Brick

DENSELY constructed of silicon carbide plus a highly refractory bond, and fired at high temperatures, CRYSTOLON Brick perform most efficiently under peak operating conditions. Their dense surface resists slag penetration, making clinker removal easy. They are unaffected by the corrosive action of coal ash slag and will not spall in elevated temperatures.

NORTON COMPANY
Worcester 6, Massachusetts

Norton Longer Lasting **Refractories**

Pipes clogged with scale can do only half their work. Scale in cooling systems, boilers or water systems cuts down the efficiency of the pipe and costs money. Haering Organic Glucosates will remove this scale and prevent further deposition.

Write today for any of our technical booklets. Better still, a Haering Field Engineer will gladly call and study your problems without obligation.

WE READ WATER

D. W. HAERING & CO., Inc.
GENERAL OFFICES:
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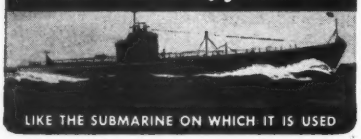
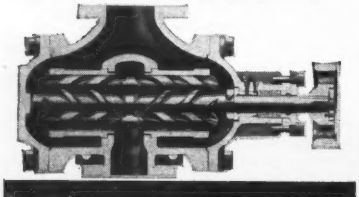
The IMO OIL PUMP
Small but Effective



LIKE THE SUBMARINE ON WHICH IT IS USED

The submarine represents the most concentrated power known to naval warfare. Similarly, the IMO oil pump provides great concentration of pumping capacity in small space. It is extremely compact, rugged, simple and reliable, having only three moving parts and no valves or pilot gears.

The IMO oil pump is used on submarines for pumping both fuel and lubricating oils. You can use this small, but effective, pump for handling oil of practically any viscosity, in any volume, and at any pressure. Ask for Leaflet 1-112.



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of the De Laval Steam Turbine Company
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have been built by this organization. . . . No charge for preliminary sketch, estimate and specifications. Our service also includes Boiler Settings, Linings for Steel Stacks, Repairs and Extensions of chimneys. . . . We shall be glad to have your inquiries.

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degree of heterogeneity of the coal at the point of sampling, such as the average ash content of the coal, the degree of ash segregation in the unmined bed, the mixing operations that occur in transit, and the size distribution of the individual pieces; second, those that depend on superimposed sampling actions, which are concerned mainly with whether the samples are taken at random or in an orderly way. Mathematical expressions and relations of these factors are established and supporting experimental data are given.

"Fundamentals of Coal Sampling," Bureau of Mines Bulletin 454, is obtainable from the Superintendent of Documents, Washington, D. C., for 20 cents per copy.

Eastern Shore Public Service Expansion (Correction)

FROM INFORMATION received since the publication of the item under the above heading on page 178 of the March, 1944 issue, it has been learned that the engineering work and purchase of equipment for this project will be done by United Engineers & Constructors, Inc., 1401 Arch St., Philadelphia, Pa., instead of the Atlantic Utility Service Corp., as was previously indicated.

Falck Succeeds Krug in WPB

DONALD M. NELSON, Chairman of the War Production Board, has announced the appointment of Edward Falck as Director of the Office of War Utilities. Mr. Falck succeeds J. A. Krug, who is leaving WPB to accept a commission as Lieutenant Commander in the Navy for assignment to active duty.

Mr. Falck has been Deputy Director of the Office of War Utilities since February, 1943, and since March 17 of this year has also served as Executive Director of the Combined Production and Resources Board. He will continue to fill the latter post while carrying his new assignment.

From 1933 to 1937, Mr. Falck was Director of Research and Rates for the Tennessee Valley Authority. From 1937 to 1941 he was Assistant to the Vice President of the Consolidated Edison Co. of New York; in 1941 he came to the Office of Production Management, at Mr. Krug's request, to serve as Chief of the Power Allocations Section of the Power Division.

Mr. Krug, whose home is Madison, Wis., was Director of Power for TVA prior to becoming head of the OPM Power Division in the summer of 1941. He became Deputy Director General and Head of the Distribution Bureau in WPB in August, 1942, and was appointed Director of the Office of War Utilities in February, 1943. In that same month he was also appointed Pro gram Vice Chairman of WPB.

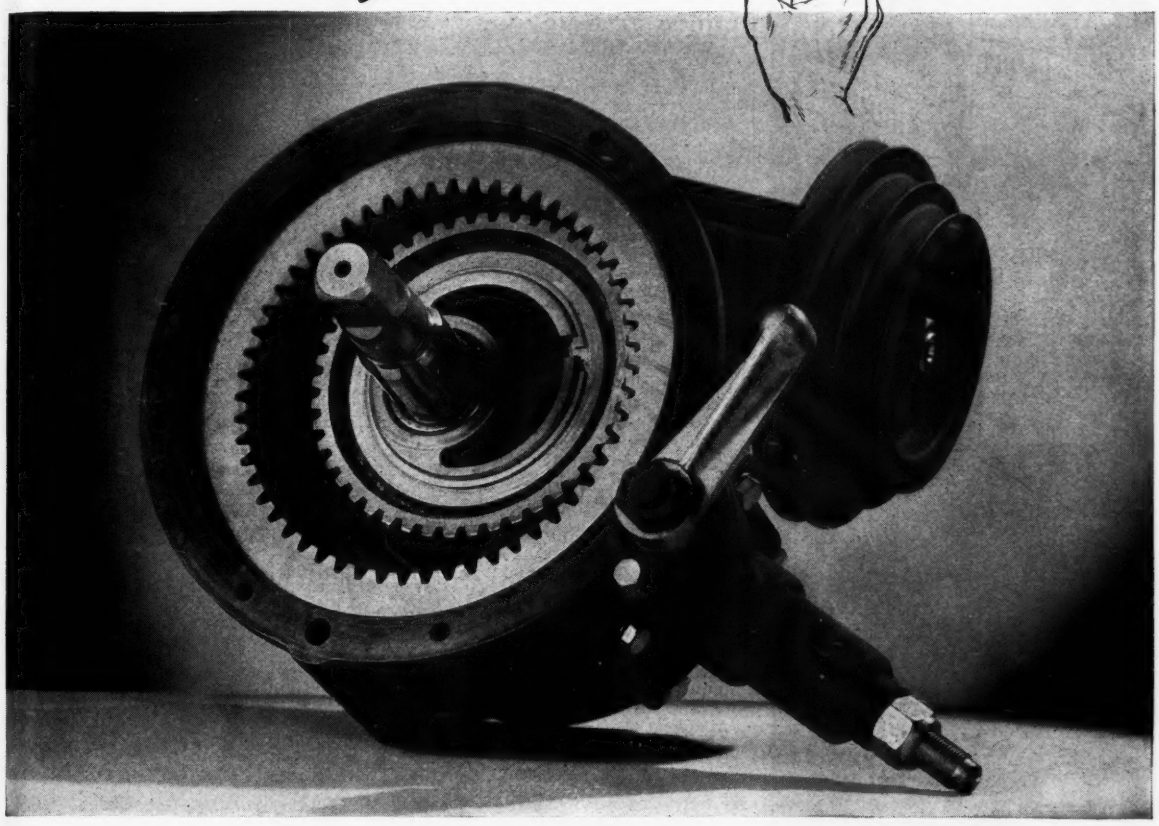
ASME to Meet in Pittsburgh

THE COMING SEMI-ANNUAL MEETING of the American Society of Mechanical Engineers will be held at the William Penn Hotel, Pittsburgh, Pa., on June 19 to 22, inclusive, for which an excellent program has been arranged that is comprehensive in character.

Pittsburgh was chosen because of its dominant position in the production of the primary products of steel and coal, making it the natural place to hold a mechanical engineers' meeting to dis-

WE ELIMINATED THIS TINY PIN

And changed the Standards of an Industry



In conventional stoker designs the transmission is protected against overload by a little metal gadget called a *shear pin*. In case of a blocked feed screw, the pin is sheared off, thereby disconnecting the motor from the driving mechanism. Until a service man can replace the pin, the stoker is inoperative.

The Winkler Stoker has no shear pin! Its transmission is fully protected against overload damage by the Winkler Safety Release. If an obstruction should block the feed screw, this device automatically and continuously *disengages* and *re-engages* the motor and transmission until the obstruction is removed. The *Winkler Stoker thereupon resumes operation without the need* for service!

Note well the construction of the Winkler Stoker Transmission. The inherent mechanical advantages of *internal planetary gearing* are ingeniously employed to provide a driving unit of extraordinary power. At the same time, this design materially reduces the heavy tooth load which causes rapid wear or breakage.

Winkler Stokers are playing an important role today in the conservation of both manpower and fuel. Your request for further information is invited.

The Winkler Stoker Inter-planetary Transmission—fully automatic and longer-lived.

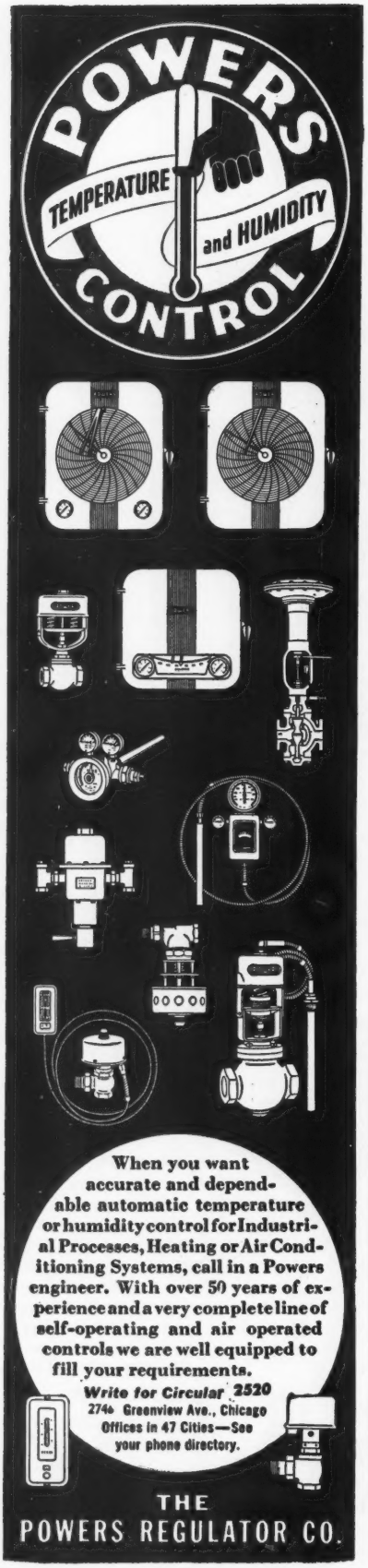
SEND FOR THIS BOOKLET

The Winkler Engineering Department has published an interesting brochure on the mechanics of inter-planetary gearing as applied to Winkler Stokers. Your request for a copy will be promptly honored.

WINKLER

fully automatic STOKERS

U. S. MACHINE CORPORATION • LEBANON, INDIANA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When you want accurate and dependable automatic temperature or humidity control for Industrial Processes, Heating or Air Conditioning Systems, call in a Powers engineer. With over 50 years of experience and a very complete line of self-operating and air operated controls we are well equipped to fill your requirements.
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cuss the problems of industry, production, transportation and management. Many interesting inspection trips have been arranged for those desirous of visiting modern industrial plants.

William G. Christy Opens Office in Jersey City

WILLIAM G. CHRISTY has opened an office at 921 Bergen Ave., Jersey City 6, N. J., where as a consulting engineer, he will specialize in combustion, boiler plants, smoke, dust and cinder abatement. Mr. Christy has for many years been in charge of the Hudson County Department of Smoke Regulation.

National Chemical Show November 15-19

THE THIRD National Chemical Exposition will be held November 15 through 19, 1944, at the Chicago Coliseum, according to announcement by M. H. Arveson, chairman of the Exposition Committee. Marcus W. Hinson, manager of the first two national shows, will direct the November exposition.

"We anticipate that the new home will do justice to the growth of the national show," said Mr. Arveson. "Satisfactory facilities will be available for the National Industrial Chemical Conference which has always been an interesting feature of the exposition as well as for the display of motion picture programs which will also be continued.

"The main exhibition hall is adequately suited for our show purposes. There are no obstructions, it has a high ceiling, and the floor load is unlimited, allowing for virtually any type of exhibit.

"The arrangement of wide aisles throughout the exposition space will provide maximum comfort for visitors and will permit convenient arrangement of exhibits so that each display is assured of maximum attention.

"Progress is being made in plans for the motion picture program as well as for the conference, and these two features again will be highlights of the exposition."

Associated on the show committee with Mr. Arveson, who is identified with the Standard Oil Co. of Indiana, are Edward Bicek of the Illinois Institute of Technology, Victor Conquest of Armour & Co., L. E. May of The Sherwin-Williams Co., C. S. Miner, Jr., of Miner Laboratories, R. C. Newton and H. E. Robinson, both of Swift & Co., and B. B. Schneider of Schneider & Dressler. L. M. Henderson of the Pure Oil Co., president of the Chicago Section, is ex-officia a member of the committee.

Headquarters for the show have been opened at 330 S. Wells St., Chicago 6, Ill.

Work to Begin Soon on Deschutes Project

BUREAU OF RECLAMATION, Bend, Ore., has plans nearing completion for first section of Deschutes irrigation project in vicinity of Bend, and will ask bids soon for different branches of work, to include addition to hydroelectric generating station at Cove, to cost approximately $300,000; new flume across Crooked River, estimated at $250,000; and miscellaneous construction to cost about $100,000. During summer it is expected to issue call for bids for other work on first section, including distribution system, laterals, canals and accessory construction, estimated to cost over

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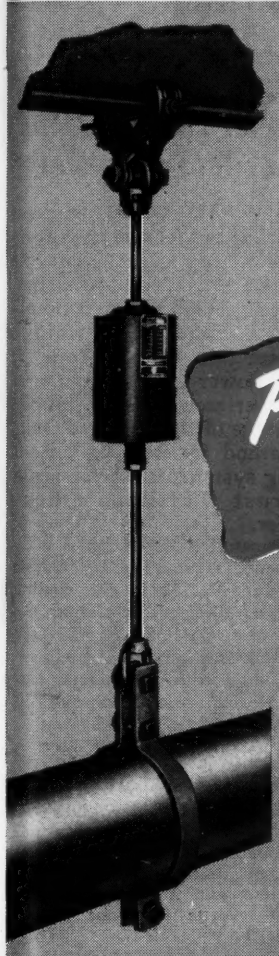

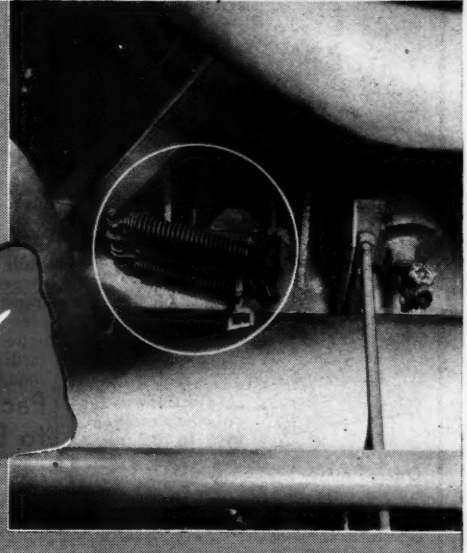

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Save engineering time required when hangers are "tailor-made" for each load condition. 14 sizes with a load range from 84 lbs. to 4700 lbs. Minimize changes in pipe supporting force • All-steel welded construction meets pressure piping codes • Unique swivel coupling provides adjustment and eliminates turnbuckle • Compact—require minimum headroom • Installation simplified by integral load scale and travel indicator • Easy selection of proper sizes from Capacity Table.

GRINNELL CONSTANT-SUPPORT HANGERS

The only hanger offering all these important features for power piping support. Constant support of piping in all "hot" and "cold" positions – full safety factor of the supported system is always maintained • Mass produced from standard precision parts • Individually calibrated for each specific installation • Rated capacity of each model varies with the size of the springs used. Overall dimensions of the hanger remain constant • Minimum headroom required.

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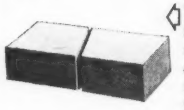
The new Clipper Multiple Cutting Principle makes possible faster cutting of every masonry material regardless of hardness.

Here are a few typical examples of the speed and accuracy with which fire brick can be cut for furnace repairs.



This acid brick intended for a chemical plant acid chamber was cut completely in two, in 37 sec.

One of many intricate cuts performed on first quality clay brick for heat treating furnaces. Made in 8 seconds.

Silica brick cut lengthwise for open hearth furnace work, only 9 seconds were required to complete this cut!

Basic refractories for steel furnaces or cement kilns must be accurately installed. This magnesite brick was cut in 12 seconds!

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$1,800,000 additional. Appropriation of about $2,500,000 has been arranged for initial section of project, with second section estimated to cost close to $3,000,000, making a total of $5,500,000, for entire development, including power lines, pumping stations, power substations and miscellaneous work. Project has secured a priority, on basis of construction of second section, noted, in 1945, when work on first section is expected to be completed. C. H. Spencer is construction engineer, in charge.

Georgia Power to Secure Federal License for Hydroelectric Project

GEORGIA POWER Co., Atlanta, Ga., has been directed by Federal Power Commission, Washington, D. C., to secure a Federal license for construction of proposed new hydroelectric generating plant at Furman Shoals on Oconee River, vicinity of Milledgeville, Ga., and it is understood that company will make application for such authority at early date. Work on this project was begun in 1929 without a license or other Federal approval, and was discontinued about a year later, owing to general economic situation. Since that time, the development has been dormant until recently, when company announced intentions of resuming construction and completing project at early date. The Commission now holds that the power dam and station would affect the navigable capacity of Oconee River, and therefore has made recommendation noted. In addition to generating plant, project will include transmission lines for connection with present high-tension system of company, power substations and other operating facilities. No estimate of cost has been announced.

Pacific Gas & Electric to Expand Facilities

PACIFIC GAS & ELECTRIC Co., San Francisco, Calif., plans extensions in certain power stations during present year, as provided by priority ratings, including installation of generating units and auxiliary equipment. Work also will be carried out on a number of power substations and switching stations, as well as transmission line extensions. In an official statement regarding total generating capacity, the company points out that gross output of all plants and power available by purchase by the close of 1944 will be about one and one-half times the combined capacity of Grand Coulee and Bonneville hydroelectric plants of Federal Government, and close to double the capacity of the Boulder Dam generating plant of Government.

Extensions Planned in Bonneville Transmission Lines

BONNEVILLE POWER ADMINISTRATION, Department of Interior, Portland, Ore., has plans maturing for construction of new 115,000-v transmission line from point near Albany, Ore., to vicinity of Newport, Ore., close to 60 miles, to be used for primary source of power supply for Lincoln County Public Power District at latter place, E. F. Altree, president. A power substation will be located in vicinity of Newport for connection with lines of Lincoln district. Surveys are being placed under way and actual construction is scheduled to begin soon, with completion next October. Dis-

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ARE YOUR Diesel engines producing the maximum power of which they are capable on the fuel consumed? Are they running efficiently, economically . . . without overheating? To meet this wartime "must", many power plant engineers and superintendents are taking advantage of the effective Oakite method for keeping Diesel cooling systems free from scale and rust that impair heat transfer.

No dismantling is required. By introducing a solution of Oakite Compound No. 32 in the cooling system as directed, insulating deposits are QUICKLY, THOROUGHLY and far more safely removed than with commercial raw acids. Normal cooling efficiency is fully restored . . . power output kept at maximum.

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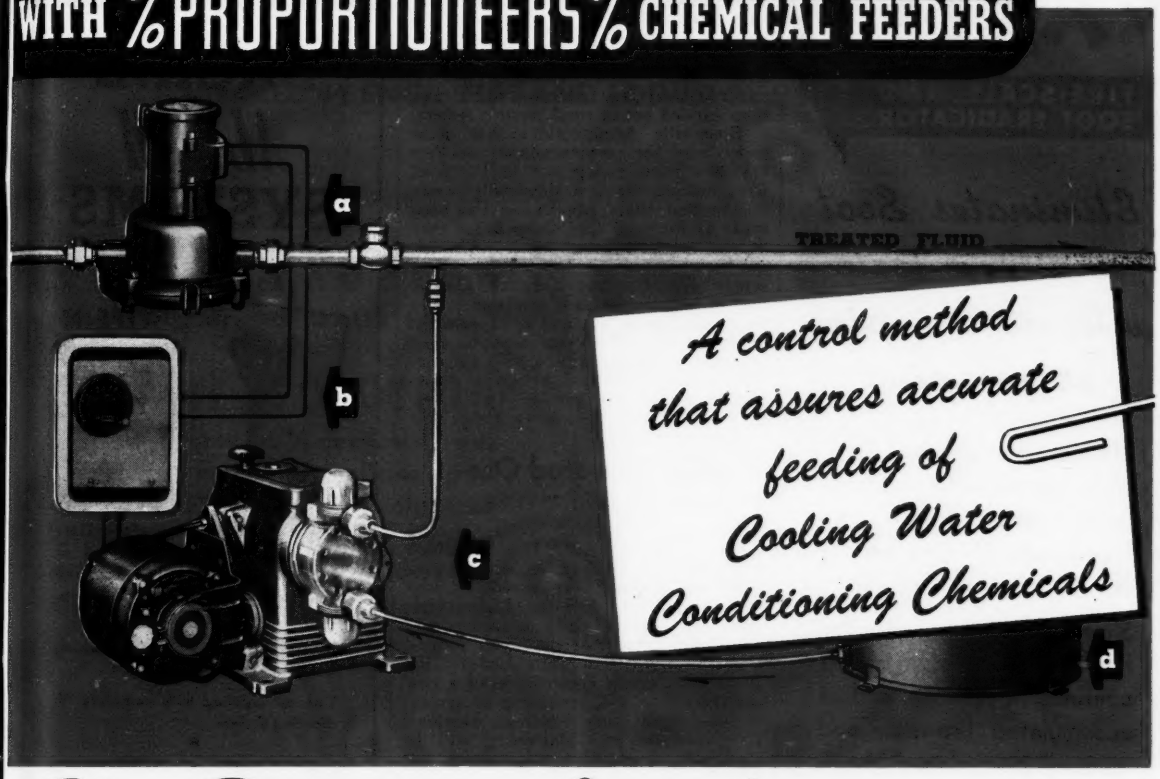

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% Proportioneers, Inc. % manufactures a full line of proportioning equipment for constant rate or flow responsive feeding of Calgon, sulphuric acid, chloramines and other water conditioning chemicals.

A special internal gear train in Meter **a** fitted with a contact switch provides an electrical impulse each time a fixed amount of liquid passes through the meter. Timer **b**, energized from contact in Meter **a**, runs through an adjustable cycle, operating the motor of the Adjust-O-Feeder **c** for a predetermined number of minutes. Adjust-O-Feeder **c** takes suction from Tank **d** and injects treating fluid into the line, assuring accurate treatment in proportion to flow.

For Constant Rate Feeding, units **a** and **b** are omitted.

For further information send for Bulletin 1100

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FIRE-SCALE AND SOOT ERADICATOR

Eliminates Soot and Fire-scale without chipping or scraping

Manual chipping of fire-scale and scraping soot from boiler heating surfaces wastes valuable time and labor, and ties up the unit.

Simply feed Xzit into the fire-box while your boilers continue to operate, and all accumulated fire-scale and soot will be reduced chemically so they can be dissipated by natural draft or blowing, without chipping or scraping.

Xzit stops sparking and extinguishes stack fires instantly. Periodic use keeps heating surfaces clean, saving fuel and reducing maintenance.

Xzit is being used in all types of stationary power plants and on board American and Allied merchant and naval vessels.

Write for demonstration in your plant.

XZIT SALES CO.

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trict has been securing power from generating station at saw and lumber mill of C. D. Johnson Co., Toledo, Ore., which will be used for standby service in future. At a later date, Bonneville Administration plans to construct additional transmission lines to a point south in Lincoln County, where distribution will be carried out by Lincoln district in that area. Another power substation will be constructed at line terminus, and extensions carried out in rural electric system.

Bonneville Administration has plans under way for construction of another 115,000-v transmission line to Portland, Ore., making the first Bonneville power line in that city. Application has been made to Portland City Council for permission to proceed with work in municipal limits. Line will be used for power supply for Portland General Electric Co., to augment present available power for local distribution, and is expected to be completed for service next summer. A power substation will be built for connection with Portland company transmission system. Bonneville Administration has secured a priority rating for project from WPB.

Electric-Operated Ore-Processing Mill

SCOTIA MINING Co., Scotia (Monroe County), Pa., care of H. M. Wallace, Sunbury, Pa., president, organized a few years ago to take over abandoned iron ore properties at first noted place, has plans maturing for early re-opening and active development of the mines, located about 4 miles from State College, Pa. Work will include construction of a new ore-processing mill, consisting of several one and multi-story buildings, equipped for large output. Machinery will be electrically-operated. A transmission line will be constructed from State College for power supply, to be furnished, it is understood, by West Penn Power Co., operating in that area. A power substation also will be built at mill site. New machinery will be installed for ore-mining service, with sufficient capacity for raw material requirements for mill. A spur railroad line also will be constructed to plant from State College. Entire program is estimated to cost about $500,000, with financing provided by Defense Plant Corp., Washington, D. C. Leo Moerschbacher, Port Matilda (Centre County), Pa., is manager of company.

Coolidge and Russian Scientist Awarded Franklin Medals

WILLIAM DAVID COOLIDGE, vice president and director of research for the General Electric Co., and Peter Kapitza, director of the Institute for Physical Problems, Academy of Sciences, Union of Soviet Socialist Republics, were awarded the 1944 Franklin Medals of The Franklin Institute, Philadelphia, on April 19.

Dr. Coolidge's x-ray tube has changed x-ray technique from an art to a science, enormously extending the range, utility and effectiveness of x-rays. In developing the x-ray tube from an inexact device to its present form—a tube with the highest possible vacuum in which an electron stream from a filament, heated by an auxiliary current, can be directed upon a tungsten target by a separately controlled voltage—he has completely revolutionized the use of x-rays, creating the science of radi-

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ENGINE *ALARM* SYSTEMS

TYPE M

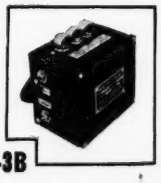
CONTACT MAKERS

Pressurestatic or Thermostatic Contact Makers for lubricating-oil or circulating-water systems for all types of stationary or mobile equipment.

Now available in sheet-steel housing to avoid critical materials.

Can be supplied with complete indicating system.

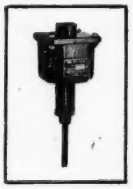
COMPLETE ALARM SYSTEM



TYPE M-3B

Complete alarm system consists of Type M-3B combination pressure control, junction box and visual indicator, together with Type M Thermostatic Contact Maker, and signal howler.

WATER- AND WEATHER-TIGHT



TYPE C CONTACT MAKERS

Where Contact Maker is exposed or must be waterproof, Type C Pressurestatic or Thermostatic is recommended.

Manufacturers of engine alarm systems, annunciators, marine and industrial instruments. Write for specifications.

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DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNIBESTOS

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Insulating large pipes (12" to 60")
6b THE SOLUTION
Use Unibestos in ½ sections from 12" to 30" and in ¼ sections up to 60". These large size sections of Unibestos provide an unbroken surface which results in lowered heat loss — higher efficiency.

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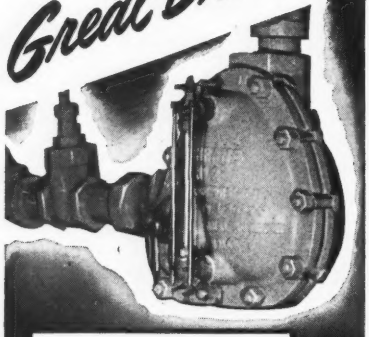
Tribute to a Great Drainer



"These traps" (Cochrane Multiport Drainers) "discharge continuously, the valve opening being determined by the height of water in the float chamber; the larger the volume of water, the larger the valve opening. The rotating movement of the sleeve valve serves to keep the valve free of sludge accumulation."

—Steam Engineer of large New England paper mill.

Two Cochrane Multiport Drainers handle condensate returns for process, in a large southern printing plant.

Cochrane Multiport Drainer draining stage heater at 360° temperature and 125 lbs. pressure on cargo vessel.

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DRAINERS

ology. He has developed the tube to a point where it can operate on much higher voltages. The greater penetrating power which results is now used in cancer research. In achieving this, Coolidge applied the cascade principle which is now used in equipment for radiographic examination of steel castings and welds to discover internal defects.

Dr. Kapitza's great work has been the invention of a method of producing extraordinarily high magnetic fields, many times greater than were previously thought possible, and the development of ingenious methods for making magnetic measurements of various kinds upon small pieces of matter exposed for a small fraction of a second to such fields.

He also designed and constructed a machine for making liquid air and liquid hydrogen which is much more efficient than any machine yet developed. It is very much smaller in size than those used previously. It is believed that the Russian Army has used liquid air for military purposes and, therefore, this work has contributed substantially to the war effort.

Motion Pictures of Fuel Beds

At a session of the Spring Meeting of the American Society of Mechanical Engineers held in Birmingham, Ala., Otto de Lorenzi, Director of Education of the Combustion Engineering Co., New York, described the use of a new tool in the form of "speed-up" motion pictures in color as a means to improving efficiency and economy of combustion.

"The general impression gained, when looking into a stoker fired furnace, is that the fuel bed is motionless, incandescent and active", said Mr. de Lorenzi. "While the actual motion is very slow, nevertheless it is positive and regular. The slowness makes it difficult for the human eye to see, follow and remember successive steps during any given cycle. Furthermore there are distractions due to the intensity of illumination, eye fatigue and sudden occurrences in sections of the furnace other than the one under observation.

"Consequently, to have a true picture of sequence of operation and resulting changes, the action must be speeded up. The amount of 'speed-up' cannot be accomplished by simply running the stoker faster, even if it were possible to reduce intensity of illumination, because action would still be too slow. Furthermore conditions that would be developed are not representative of those at normal rate of operation. Another difficulty encountered in trying to set up or reproduce certain fuel bed action is that no two observers see the same sequence of occurrences unless there is ample repetition. As a result, there may be differences of opinion as to cause and effect. Conclusions or suggestions for remedies will vary. Considerable time may be lost in arriving at designs or changes required to produce desired results.

"A valuable tool, in the form of 'speed-up' motion pictures, is available for analyses of this type. With its use the stoker may be operated normally. The exposure rate can be adjusted to secure any desired degree of speed-up. The resulting picture is then projected over and over again, reproducing every detail and sequence of operation. The accelerated action permits a careful study of changes as they occur. Repetition enables all observers to see the

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MECHANICAL ENGINEER, thoroughly experienced engineering design mechanical sections of steam power plants for industrial and utility applications involving moderate to high pressure-temperature steam and efficient burning various fuels. Should have administrative and executive ability and capable further development. Age 35-45. First reply must give full particulars as to age, education, specific experience in detail, availability, draft status, salary, etc.; attach photograph which will not be returned. Location New York. If now employed at highest skill, do not reply.

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AGENCIES WANTED

Our Minneapolis Office can handle one or two additional lines. We now have a line of rotary pumps and flexible couplings. Additional agencies should be for products used by machinery manufacturers, machine shops, or food industries.

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HELPFUL BULLETINS

Practical answers to many wartime problems of plant operation and maintenance are found in the engineering bulletins offered by manufacturers. For your convenience we publish the following summary of helpful literature available. To obtain copies of the bulletins and catalogs described, simply indicate the paragraph numbers on coupon on next page, detach and mail.

BOILER PLANT EQUIPMENT

1 Gas and Oil Burners — Bulletin No. R-1 contains a description of the operating principle, dimension chart and performance curves for the Webster Series R combination gas and oil burners. A useful reference for all combustion engineers. The Webster Engineering Co.

2 Spreader Stokers — Bulletin No. 78 describes the Fyr-Feeder multiple spreader type stoker under the theme "burns coal like oil." The principle of the multiple spreader stoker is included with detailed illustrations and installation data. American Coal Burner Co.

3 Quick Steam-Cost Calculator — Steam plant operators will want this quick steam-cost slide rule calculator. Figures steam costs for both oil or coal. Cleaver-Brooks Co.

4 Unit Type Stoker—Bulletin No. 600 tells about savings of Detroit Uni-Stokers in various industrial plants. These single retort, plunger feed, unit type stokers are flexible in operation, burn all grades of coal, serve boilers 125 to 300 hp. Detroit Stoker Co.

5 Continuous Blow-Off Bulletin—The Cochrane Corp. bulletin 4081 on Continuous Blow-Off Systems illustrates the application of this heat-saving device that should be a part of every boiler room auxiliary equipment. The bulletin explains the heat saving that can be accomplished, the advantages from the standpoint of regulating boiler concentrations, the type of equipment available for different heat balance requirements, as well as illustrations and photographs of installations, heat exchangers, etc.

6 Combustion Control—New Bulletin BD-44 discusses the importance of a simple combustion control system in saving fuel; contains photos and diagrams showing application of Enco control equipment for furnace-draft, stoker-speed, and forced-draft control. The Engineer Co.

7 Plug Feed Skip Hoist Loading Gate —Bulletin No. 92, just released by The C. O. Bartlett & Snow Co., describes the company's new plug feed type skip hoist loading gate for coal and ash systems. The bulletin has "progress photographs" showing how arms on the skip bucket release a latch on the gate, permitting the self-damming feed chute to be lowered into the position on rollers—and returned to latched position when the skip bucket is raised—avoiding friction, wear, noise and spillage.

ELECTRICAL

8 Electrical Connectors — Technical Bulletin 6050 tells about construction features and speedy economical application of Burndy indent type electrical connectors. Made in one piece of pure copper, these connectors insure high electrical conductivity. Burndy Engineering Co.

9 Rapid-Release Latches for Circuit Breakers—"Rapid-Release Latches for Circuit Breakers," by Carl Thumin, Mechanical Engineer, discusses the design of deadcenter and overcenter latches. Equilibrium diagrams are shown for both frictionless and frictional operation. Design hints are included for reducing strains caused by load and for eliminating the effects of impact in high-speed operation. This is I-T-E Bulletin 4312.

10 Low Temperature Welding — New 8-pg folder describes use of Eutectic low temperature welding rods for quick repairs on engine blocks, crankshaft casings, pulleys, etc.; for surfacing bearings, guides, valve seats and shafts. Contains helpful Eutectic rod selector table; lists technical literature available. Eutectic Welding Alloys Co.

11 Maintenance of Electrical Equipment—A 28-pg booklet of convenient pocket size entitled "Care and Maintenance of Electrical Equipment" and containing simple instructions for keeping switches, panelboards and switchboards in good operating condition is announced. Book contains a parts ordering list of Square D electrical equipment. Illustrated; may be obtained without cost. Square D Co.

12 Drying Electrical Equipment—How a few kw's of infrared can speed up baking and preheating jobs, dry out motor windings and control panels, bake insulating varnish on motor parts, etc., is covered in new bulletin on Evenray heaters. Maintenance departments also use them for thawing frozen pipes and removing paint. The Fostoria Pressed Steel Corp.

13 Current Regulating Compensator for Welding—New Bulletin GEA-4207 deals with operation and applications of an electronic current regulating compensator for G-E thyratron-welding control. Contains characteristic curves of compensator showing small variations in welding current for changes in line voltage. General Electric Co.

14 New Booklet on Power Centers—For quick installation in war plants, shipyards, hospitals, and similar applications, Power Centers—compact, coordinated unit substations available in all standard ratings—are discussed in a new 25-pg booklet announced by Westinghouse Electric and Manufacturing Co. It contains a timesaving guide to the selection and specification of indoor and outdoor transformer installations, including coordinated disconnect and protective equipment. Standard arrangements are suggested to fit the various types of distribution systems. Factory-assembled and tested, Power Centers combine all transformer and switching material in one unit.

FANS, PUMPS AND COMPRESSORS

15 Feather Valve Compressor — With brief text and interesting colored sectional views, Bulletin 1-667-B1 describes the construction features and operating advantages of Worthington feather valve compressors. These compact units are said to require one-fourth the foundation normally required for same capacity horizontal compressor. Worthington Pump and Machinery Corp.

16 Facts About Rotary Pumps—Bulletin No. 304 entitled "Facts about Rotary Pumps" pictures the operating cycle, buckets, rotor and other features of Blackmer rotary pumps. Also shows single unit, twin unit, V-belt and Steam turbine drive, and various pump types; contains capacity curve and other useful data. Blackmer Pump Co.

17 Chemical Proportioning Pumps — Available in 8 types in over 200 sizes for any applications involving pressures to 22,000 psi and capacities from 0 to 1800 gph, Hills-McCanna chemical proportioning pumps will feed the proper proportion of treating agent regularly, and without fail. Write for Catalog P-41 for complete details and engineering data. Hills-McCanna Co.

18 Heavy Duty Air-Cooled Compressors—New 56-pg Bulletin A-52 describes the Sullivan line of heavy duty two-stage air-cooled for industrial plants and mines. Twin units have common double shaft motor. One compressor with motor can be installed and twin compressor added when required. Bulletin shows many installations; tells about available sizes, construction details, servicing. Sullivan Machinery Co.

19 Steam Jet Vacuum Pumps—Detailed descriptions of Schutte & Koerting single- and multi-stage steam jet vacuum pumps, in many sizes and types for low and high vacuum work, are contained in a new 36-pg bulletin, No. 5-EH. Full color sectional drawings show features of construction and principles of operation. Characteristics of various types are outlined and typical applications shown. Schutte & Koerting Co.

20 Rotary Gas Boosters—Bulletin 32-33-B12, covering rotary positive gas exhausters and boosters, has just been issued by Roots-Connersville Blower Corp. Bulletin includes a number of curves, diagrams, cross-sections, etc. Foreword traces inception of the two-impeller displacement principle by the Roots brothers about 1854, showing the various adaptations to which machines of this type have been put through the intervening years. Advantages claimed by the manufacturer for this type of equipment are discussed, along with sections devoted to the operation principle, features of design and construction, and efficiency curves.

INSTRUMENTS AND CONTROLS

21 Renewal Parts for Watthour Meter —Helpful information on ordering renewal parts for V-type two element polyphase watthour meters is given in new Bulletin GEF-2721A. Includes illustrations of typical meter parts; useful memoranda pages. General Electric Co.

22 Thermocouple Data Book—New edition of Wheelco Thermocouple Data Book and Catalog gives a description of products, prices and recommendations for thermocouple users; suggests substitutes for restricted materials. It carries

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the latest amendment to the WPB's Conservation Order L-134, and gives data on selection of thermocouples, lead wire, protecting tubes, heads and insulators. Also carried are temperature conversion tables, millivolt tables, and tables on pipe and wire sizes, decimal equivalents and wire resistances. Instructions are given on checking thermocouples and pyrometers, and on construction of thermocouples. Wheelco Instruments Co.

23 **Bulletin On CO_2 Indicator**—Bulletin 341 has just been issued describing the Fyrite CO_2 Indicator and its use in saving fuel. A helpful new feature of this bulletin is a table showing "Causes and Corrections" of inefficient combustion. A simplified graph shows heat loss in relation to percentage of CO_2 in flue gases. Also described is the Bacharach Fire Efficiency Finder, a unique calculator that correlates stack temperature and CO_2 readings to show at a glance total preventable stack loss in heating efficiency percentages. Bacharach Industrial Instrument Co.

24 **Cam Program Timers**—New folder covering a widely used synchronous-motor-driven ATC cam program timer. Operating principle and types available described fully. These timers are said to offer the simplest means for accurately controlling the sequence and duration of a series of three or more individually timed machine or process operations. Types are described in easily selected charts for providing continuous Repeat-cycle operations or Stop-cycle timing functions. Automatic Temperature Control Co.

25 **Automatic Control Instruments**—Well illustrated folder describes operating features and applications of Bristol automatic controllers, flow meters, pyrometers, pH recorders and other control instruments. Typical war plant installations also shown. The Bristol Co.

26 **Combustion Control**—To show some recent installations of its full-metered system of combustion control, the Leeds & Northrup Co. has issued a revised Metermax Catalog N-01 M-163. It presents in special photographic form illustrations of the various features of design which are said to contribute to the equipment's reliability. This publication will be of special interest to anyone in central station or large industrial power plant, who may desire information on recent installations.

PIPING, VALVES AND FITTINGS

27 **Butterfly Valves**—New 4-pg illustrated Bulletin No. 16-B contains complete dimension tables for butterfly valves, 15 to 125 psi. Features valves for regulation and shut-off duty for air, gas, steam, liquids and semi-solids—manual and automatic control. Issued by R-S Products Corp.

28 **New Purger Bulletin**—An 8-pg bulletin describing Armstrong non-condensible gas purgers for removing air and other non-condensibles from refrigerating systems has just been published. Three subjects discussed include: the effect of excess head pressures on power costs; causes of high condensate pressures; sources of non-condensible gases; how to tell when purging is needed, etc. Bulletin also includes the operating principle of the Armstrong purger, installation diagrams, cross-sectional views users' reports, and installation pictures, prices and physical data. Armstrong Machine Works.

29 **Tilting-Disc Check Valves** — New 12-pg booklet tells how cushioned closing of Chapman tilting-disc check valve prevents slamming, hammering, surging on your lines. Includes helpful engineering data, test results, installation pointers. The Chapman Valve Mfg. Co.

30 **Marine Products** — Zurn scupper valves, suction line strainers, foot valves, drains and other marine products are pictured and described in new Catalog No. 43. J. A. Zurn Mfg. Co.

31 **Welding Fittings and Flanges**—For stronger, lighter, permanently leak-proof piping systems, many plants use Tube-Turn fittings. No torch cutting or fitting fabrication needed. Helpful catalog and data book No. 111 contains 232 pg of technical studies and engineering data. Tube Turns, Inc.

32 **Pipe Thread Compound** — How Copaltite plastic gasket and pipe thread compound helps hold against pressure, heat, cold, gases, alcohol, etc., is described in recent bulletin. Applications listed for this compound include turbine joints and flanges, boiler manhole covers, joints of ammonia or freon compressors, combustion control systems. Bulletin also describes Tempseal refractory and insulating cement. National Engineering Products, Inc.

33 **Pipe and Tube Bending Handbook** —New 84-pg handbook covers practical methods for bending pipe and tubes of copper, brass and related alloys. Contains many illustrations of typical pipe bending operations, tables to determine sizes, weights, bursting pressures, etc. Design and operating engineers will find this a useful reference. Copper & Brass Research Association.

REFRIGERATION AND AIR CONDITIONING

34 **Cold Room Conditioning**—Bulletin 95 tells how the Niagara no-frost method provides cold rooms with low temperatures for freezing, for testing or stabilizing parts, or cold storage. Because moisture is removed there is no frosting of cooler coils or condensation on room equipment. Niagara Blower Co.

35 **Air Conditioning Maintenance** — Maintenance of air conditioning and humidifying equipment in metal-working plants, hospitals, textile mills, tobacco factories, food plants, bakeries, dairies and in many other industries is discussed in the feature article of the January-February, 1944, issue of Oakite News Service. Gives data on how effective cleaning and related techniques help solve four major problems of scale, slime, odors and corrosion. Interesting case histories which state actual, on-the-scene methods and results are included in this article. Oakite Products, Inc.

36 **Industrial Type Unit Dust Collector** —Features and construction specifications, together with the capacities and dimensions, of the new Pangborn Industrial Type "CK" Unit Dust Collector, are covered by Bulletin No. 910. Of particular importance is the flexibility in arrangement permissible for adaptation to specific plant conditions. In three sizes with capacities to 1000, 2000 and 3000 cfm. Pangborn Corp.

37 **Air Filter**—Badger Type P air filter, designed for higher filtering efficiency in air conditioning and ventilating systems, is described in new bulletin. Contains table of sizes and capacities; actual performance charts. Air Devices, Inc.

WATER TREATMENT

38 **Boiler Water Conditioning** — 15-pg bulletin No. 504 covers boiler water conditioning; explains types of impurities in boiler feedwater and how they accumulate; causes of boiler scale, sludge, corrosion and carryover. Describes Elgin Deconcentrator. Elgin Softener Corp.

39 **Degasification of Water** — Bulletin 4076 "Degasification of Water" illustrates a number of equipments that are available for removal of gases from water at various temperatures. The bulletin illustrates means provided for removal of oxygen and carbon dioxide from water without the use of steam, the removal of small quantities of ammonia, the removal of hydrogen sulphide and carbon dioxide simultaneously, as well as illustrating different designs of Cochrane deaerators available for elimination of gases in connection with boiler plants. Cochrane Corp.

40 **Problems in Water Deposits**—A reprint of a paper by Messrs. Holmes and Walker, "The Interpretation of Analyses and Problems Encountered in Water Deposits" is available for distribution. The paper covers the problems of investigating scale samples, and methods used to identify components of the scale. National Aluminate Corp.

41 **All-Colloidal Water Treatment** — Booklet describes the action of K.A.T., an all-colloidal organic method of water treatment. Its action is said to be simultaneous and two-fold against scale and corrosion; encases all scale forming particles with a film and creates a heat-conductive organic film on all surfaces it contacts. American K.A.T. Corp.

42 **Purification of Water** — Bulletin W-212-B4 tells all about the Worthington Ion-Exchange process for the purification of water. This method uses a granular insoluble material which imparts unobjectionable ions to water in exchange for "hardness" or other ions of an objectionable nature. Well illustrated. Worthington Pump and Machinery Corp.

MISCELLANEOUS

43 **Welding and Cutting Apparatus** — Victor Welding and Cutting Apparatus Unit Bulletin, Form 20, pictures in a striking manner the construction features and operating ranges of their oxy-acetylene welding and cutting equipment. Has data of value to plant maintenance men. Victor Equipment Co.

This coupon must be filled in completely in order to secure the literature you request. Please indicate only the bulletins you particularly desire. Pasting coupon on penny postcard saves you time and money.

MAY, 1944

POWER PLANT ENGINEERING

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44 Protective Coatings Index — New folders "Bitumastic Blocks" and "Bitumastic Visual Index" describe Bitumastic protective coatings for power and industrial plants. Large sectional diagram of plant visualizes many uses of these coatings for: cooling towers, condensing coils, boiler fronts, hot air ducts, motors, generators, pumps, pipelines, metal tanks, transmission towers, structural steel, etc. A useful reference book for operating engineers and maintenance men. Wailes Dove-Hermiston Corp.

45 Packing Selection Data—Free book "Quaker Packing" contains data covering every packing need against steam, air, gas, water, oil, brine, ammonia, acid, gasoline, asphalt and tar products. Quick and easy recommendation tables will aid you in solving your packing problems. A copy should be in every engineer's library. Quaker Rubber Corp.

46 What to Do About the Oil Shortage —The current issue of the Honan-Crane publication "On Land and On Sea" should be of interest to every user of lubricating or other industrial oils. Briefly reviews the highlights of current oil shortages and the part that Oil Purification can play in relieving this shortage. Other topics include—Safely extending the useful life of oil—Savings represented by effective purification—Straining versus purification—Range of application of oil purification equipment —Proven engineering features. Honan-Crane Corp.

47 Belt Hooks—New folder describes Jewell malleable iron belt hooks and lists prices. No bolts or rivets required; easily installed; can be shipped immediately. Jewell Belt Hook Co.

48 Vibratory Material Handling Equipment — Catalog 435 furnishes information on electric vibrators for coal bins, hoppers and chutes, vibrating feeders and feeder machines, hydraulic vibrators, replacement shaft seals, concrete vibrators, electric hammers and portable gasoline hammer concrete breakers and rock drills. Syntron Co.

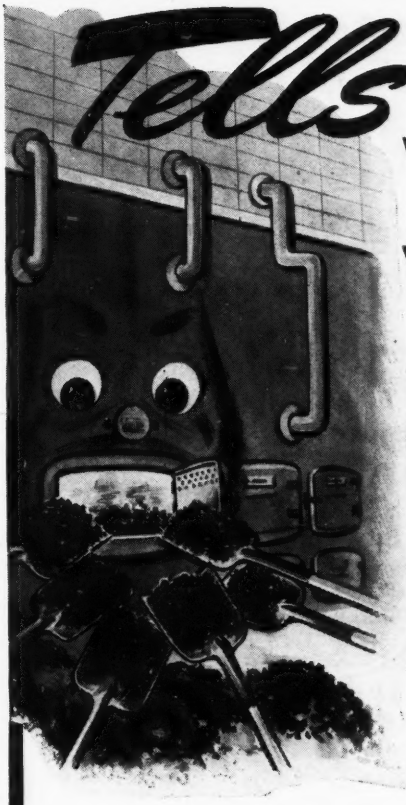
49 Carbon Seal Rings—An illustrated booklet, dealing with carbon seal rings and their application to the bellows type shaft seals, has just been issued. Information is given on steam turbine seals, air seals, seal noses, etc. Drawings of seal designs are included, as well as particulars regarding adaptability of various types of seals to other applications. Pure Carbon Co., Inc.

50 Storage-Tank Oil Heater — A new bulletin on the G-Fin storage-tank oil heater explains the unique construction of the G-Fin elements which assures a lasting bond between fins and tubes or pipes and explains the different arrangements in which the heater is furnished, together with complete tables of dimensions and ratings. The Griscom-Russell Co.

51 "Properties of Some Metals and Alloys"—A new 24-pg booklet explains the practical meanings of technical terms used in measuring the mechanical properties of metals and alloys. Describes the tests for measuring the properties of metals and explains how metals and alloys are judged by their properties. The International Nickel Company, Inc.

52 Helpful Gasket Chart Available — An up-to-the-minute Gasket Chart showing the cross-sections of 36 most popular gasket types, their purposes and the characteristics which fit them for specific services, is now available. It is featured in second issue of "The Gasket"—a series of papers on Gaskets compiled by Goetze Gasket and Packing Co.

53 Safe-Line Wire Rope Clamps—New folder describes the strength, safety and simplicity of Safe-Line wire rope clamps. No special tools required; can be set up in field or shop, exerts uniform grip. National Production Co.



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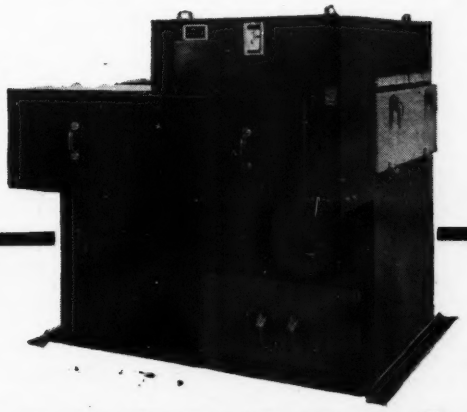

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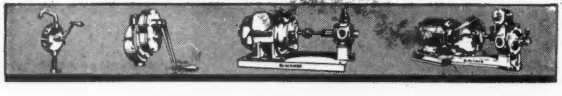

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same thing and thus concur in their understanding as to cause and effects. Recently a series of 'speed-up' studies were made on the several principal types of stokers. The object was to assist in an analysis of coal behavior in the various fuel bed zones."

NEW ENGINEERING BOOKS

Elements of Mechanical Vibration. By C. R. Freberg and E. N. Kemler. 5½ by 8½ in., 189 pp, cloth binding. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. Price $3.00.

As we have pointed out during the past few months, the subject of mechanical vibration is becoming increasingly important because the trend of our present engineering developments is toward increasing speeds and heavier loads, involving higher dynamic stresses caused by increased vibration.

Indicative of this is the appearance of Mechanical Vibration by R. E. Bernhard, reviewed on page 200 of the December, 1943 issue of POWER PLANT ENGINEERING, and Fundamentals of Vibration Studies by R. G. Manley, reviewed on page 196 of the April, 1944 issue. Here is a third book on the subject by two professors in the mechanical engineering department of Purdue University.

This book by Freberg and Kemler falls into the same general classification as that by Bernhard; namely, an exposition of the fundamental principles without the necessity of using the most advanced mathematics. Attention was called to this in the review of Mr. Manley's book. He is an Englishman and, as we pointed out, his book is obviously written for a group of readers much better versed in the higher mathematics than is the average American mechanical engineer. Messrs. Freberg and Kemler, however, attack the subject from much the same point of view as Mr. Bernhard.

It is the purpose of their book to discuss in detail the more elementary phases of vibration and reduce them to a form in which they can be applied to practical problems. Although there are many problems in the field of vibration that can be solved only by using the methods of advanced mathematics, there are also many problems that can be solved by using the simpler forms of differential equations, the approximate methods developed, or the mobility method. These methods can be readily mastered by engineers and students.

Examples have been included to illustrate the methods, units and application of the formulas developed. The mobility method has been introduced. This offers a relatively simple means of determining the behavior of systems of several degrees of freedom.

The book, after a short introduction, begins in Chapter II with a discussion of vibrations without damping. This includes a treatment of free vibrations of spring and weight without damping and examples of free vibration without damping, also forced vibrations without damping. Chapter III discusses damped vibrations, including free vibrations with damping, forced vibrations with damping and steady state forced vibrations with small damping. Chapter IV treats vibration of systems with several degrees of freedom; Chapter V vibration isolation and absorption; Chapter VI equivalent systems; Chapter VII the mobility method, and Chapter VIII mechanical and electrical models of vibration systems.

The authors recommend that the student familiarize himself with such excellent treatises as those by Timoshenko, Den Hartog, Wilson and Kimball. They give an extensive bibliography in which these authors and others are referred to. The illustrated problems are of the most practical kind and the book is well illustrated with diagrams, graphs and tables.—C. R. E.

Illustrated Technical Dictionary. By Maxim Newmark. Size 6 by 9 in., 352 pp, cloth binding. Published by The Philosophical Library, Inc., 15 East 40th St., New York 16, N. Y. Price $5.00.

The intent of this dictionary is to supply a wide and representative selection of officially approved, standard definitions promulgated by various United States engineering, technical, trade and industrial organizations, as well as by governmental agencies. The number of terms included for any single subject was determined on the

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basis of whether that subject is fundamental in all fields and whether or not it has current importance in the world of technology. Broad coverage has been given to fields of current importance in the war effort and in war technology, particularly the aerodynamics of flight, air and marine navigation, meteorology, photography and surveying. Priority has been accorded those terms likely to be encountered in the general curricula of technical and vocational schools.

A great many new terms, as well as old terms which have recently come into prominence, are defined in this book. Advances in electronics, in the synthetics of rubber, plastics and textiles and in the aircraft manufacturing industry are represented in full by many new expressions and phrases. A few examples of these are: butadiene, cetane rating, cyclotron, pliofilm, and so on.

One of the most interesting features of the book occurs in both body and appendix where, to increase the usefulness of this dictionary in shop, school and library, many items of supplementary information have been included. Among these are tables of abbreviations, standards and measurements, mathematical, scientific and technical symbols, conversion tables, shop data and formulas.

Noting the title, the average reader might be led to think that each term is illustrated by a picture or a diagram. This, of course, would not be possible in a book of practical dimensions. However, the author states that he has used particular care in the selection of illustrations. Those of a merely pictorial or inspirational type, he says, have been deliberately avoided in favor of detailed and labeled mechanical drawings, diagrams and ideograms.—C. R. E.

Guide to Weldability of Steels. First edition, 90 pp including tables and charts, 6 by 9 in., paper. Published by American Welding Society, 33 West 39th St., New York 18, N. Y. Price $1.00.

This guide is intended to present and to facilitate a prompt and thorough test by welding engineers of the system of ductility predetermination here proposed. It is divided into three parts as follows: Part I is designed to be an explanation of the system proposed for the predetermination and preservation of desired ductility in the heated zone of higher carbon and low-alloy steels during welding. For the engineer this part orients the ductility problem with respect to the other base metal properties involved. Part II is planned as an instruction manual, with step-by-step examples showing the use of the system to select steels and to predict welding conditions necessary for the preservation of desired ductility in the heated zone. Part III explains the experimental basis of the system.

How to predetermine or otherwise handle loss of ductility in the base metal next to a weld has long been a problem. The purpose of this book is to present a practicable method of handling this situation. Aside from the data in the book, only two tests are required—an end quench on the steel and a notch-bend test of the steel.

Loss of ductility next to the weld is the result of hardening due to too great a rate of cooling in the welding operation. The rate of cooling is determined by the rate of heat input (current, voltage, speed) and the rate of heat extraction (mass and temperature of the base metal). These have been combined so that rate of cooling for any common welding condition may be read directly in the tables. It is expressed in terms of distance from the quenched surface of an end-quenched bar. The closer to the quenched surface that is, the less the distance, the greater the rate of cooling.

From an end-quench test on any of the constructional steels, the hardness resulting from any cooling rate (again expressed in distance from the quenched end) may be readily determined and by subjecting a notched bar to that rate of cooling (getting the same hardness), the ductility of that steel under those welding conditions is predetermined. A tentative specification for average conditions is 20 deg notched bar bend angle for weldments not to be stress relieved, and 10 deg for weldments to be stress relieved.

Beloved Scientist. By David O. Woodbury. First edition. 358 pp, 6½ by 9¼ in. cloth. Illustrated. Published by Whittlesey House, McGraw-Hill Book Co., 330 W. 42nd St., New York, N. Y., 1944. Price $3.50.

This is a biography of Elihu Thomson, famous scientist and electrical engineer of the pioneer era of the electrical age, and, as such, it is more than a biography of one person. It is really a history of the electrical industry and its founders. Throughout the book one finds intimate portraits of such men as Edison, Westinghouse, Steinmetz, Kelvin, Crooks, Marconi and a host of

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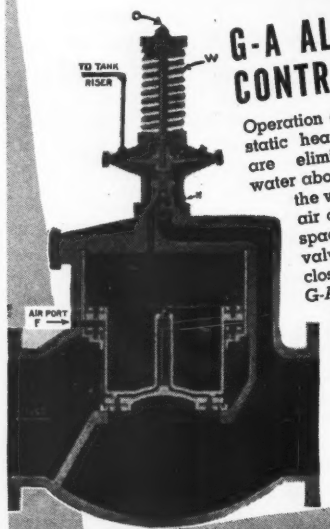

Operation of these valves is by static head. Surges or shock are eliminated because the water above the piston cushions the valve in opening, while air drawn into the annular space through the port in valve body prevents valve closing too quickly.

G-A Altitude Control Valves come in sizes 2 in. to 36 in., in either globe or angle pattern. May be closed three ways. Write for your free copy of the G-A Catalog. It describes entire line.

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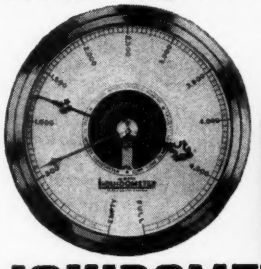

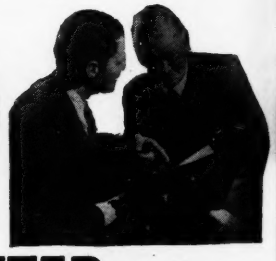

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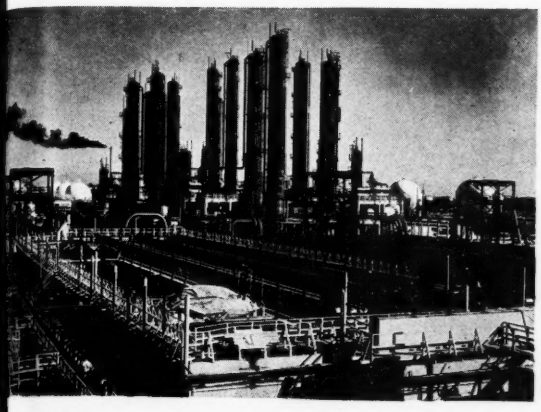

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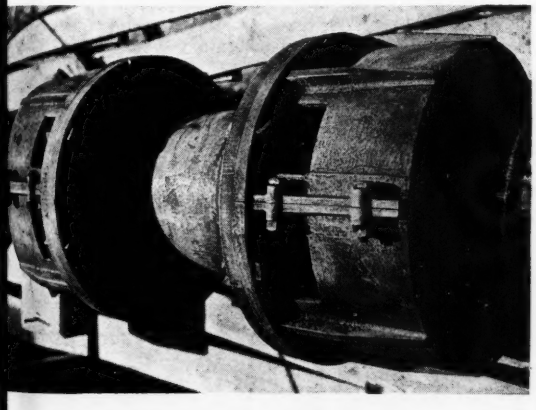

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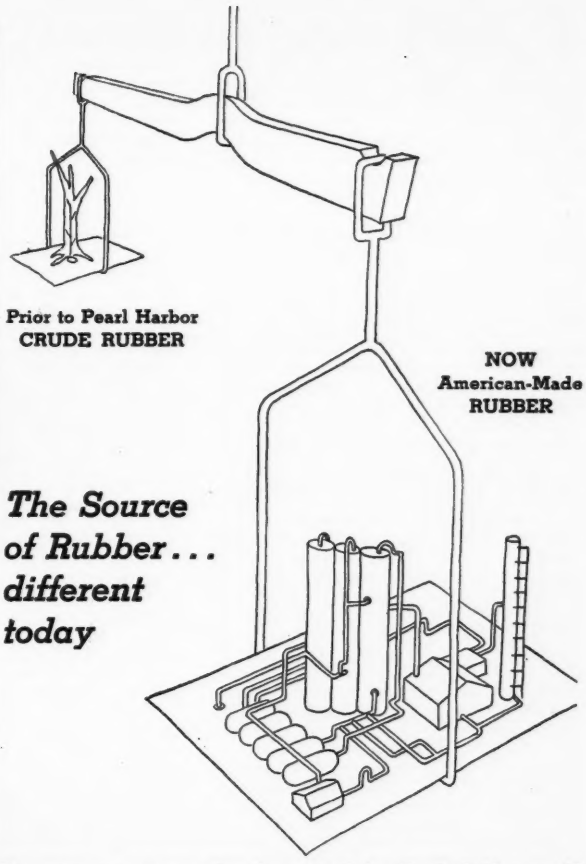

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others whose paths crossed in the early development of the electrical art.

Elihu Thomson fits into this assemblage of electrical personalities as one of the most interesting of them all. His youthful precocity, his years of laboratory experiments in his own home, his life as a student and later as a teacher and professor, and finally his great career as an inventor make interesting reading, especially to persons having a background in the electrical art.

Elihu Thomson had nearly seven hundred patents to his credit, many of which are basic and in universal use today. More than that, he was a philosopher and one of the world's great teachers. For many years he was acting president of M. I. T. and served on the Board of Trustees.

There is no question that Elihu Thomson was an outstanding man but, of course, in viewing his life as it is presented in this book, one should keep in mind the fact that Elihu Thomson lived at a time when little or nothing was known about anything electrical and any man with an inventive mind could make new discoveries. This is not said in disparagement, indeed, the same was true in regard to all the other pioneers, Edison, Westinghouse, Marconi, etc. They lived in a fertile time when almost any idea could blossom into some important development. While they accomplished great things, they missed many chances—Edison's discovery of the Edison effect, for example. Here, Edison had in his grasp, the beginnings of the whole field of electronics and radio, but he let it slip by.

While Elihu Thomson was little known to the layman, his inventions and discoveries and his general influence on engineering are woven deep into the fabric of our material progress. Mr. Woodbury's book about him is well worth reading. A. W. K.

Bulletin No. 348, "Fuel Savings Resulting from Closing of Rooms and from Use of a Fireplace." By Seichi Konzo and Warren S. Harris, has been issued by the Engineering Experiment Station of the University of Illinois. Until September 15, 1944, or until the supply available for free distribution is exhausted, copies of Bulletin No. 348 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.

This 36-page booklet describes studies made of the fuel savings to be effected by closing of rooms in two insulated houses in which the heating systems were automatically controlled. One house was heated by means of a gas-fired, forced-air system and the other by means of an oil-fired, forced-circulation, hot-water system. In both houses the windows, including those in bedrooms, remained closed at all times.

In all cases, the actual reduction in fuel consumption was materially less than anticipated reductions based on floor area, room volume, and heat loss, since in computing the anticipated savings no account could be taken, either of the orientation of the unheated rooms with respect to the heated portion of the house, or of the adverse changes that might take place in the operation of the plant as a result of shutting off registers or radiators. Hence, any broad generalization that closing of rooms will result in material reductions in fuel consumption must be regarded with some caution.

Tests were conducted also with and without the use of the fireplace in the living room. In order to obtain the maximum fuel conservation of the main heating plant with the least disturbance to comfort conditions in the house, the following method of operation was found to be desirable:

(1) Use the fireplace fire in the living room and reduce temperature, either manually or automatically, in all other rooms in the house.

(2) Use the fireplace in mild weather in fall, early winter, and spring.

(3) Use the fireplace only on relatively calm days.

(4) Close the fireplace damper when the fireplace is not in use, or place a tightly-fitting cover over the front of the fireplace after the fire has died down.

Circular No. 48, "Magnetron Oscillator for Instruction and Research in Microwave Techniques." By J. Tykocinski Tykociner and Louis R. Bloom. Issued by the Engineering Experiment Station of the University of Illinois. Until September 15, 1944, or until the supply available for free distribution is exhausted, copies of Circular No. 48 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.

This 30-page booklet describes a reliable microwave oscillator for the range of frequencies from 1700 to 5000 megacycles, corresponding to wavelengths 17 to 6 cm, which is convenient in laboratory work for instruction as well as research. It is easily adaptable for a great range of experimental work such as demonstrating the prop-

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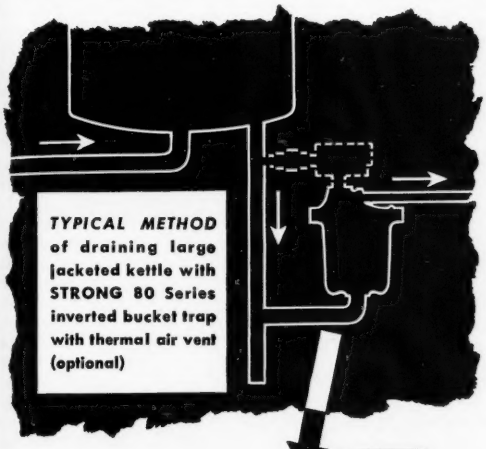
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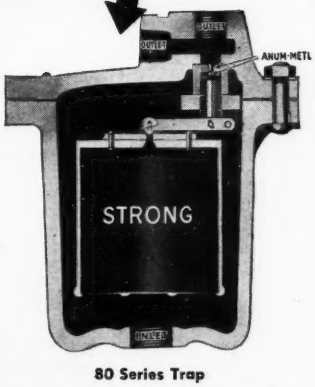

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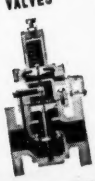

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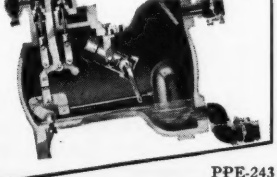

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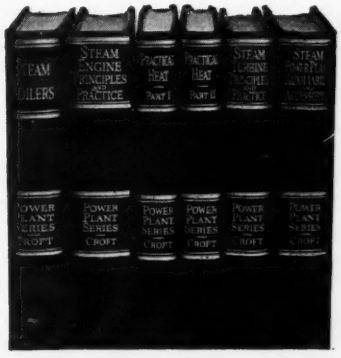

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erties of short electromagnetic waves, methods of measuring wavelengths, mapping radiation field patterns, and propagation of waves in free space. along wires, concentric lines, or through guides.

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(4) Study of transmission along parallel wire systems, coaxial cables, and guides.

(5) Comparative study of various radiating systems.

(6) Determination of wavelength by various methods.

(7) Calibration of crystal detectors and bolometers.

(8) Study of radiation patterns of reflectors, horns, and guides.

(9) Decrease of radiation intensity as function of distance from source.

(10) Polarization, reflection, and refraction of radiated beams.

Sufficient details are included in the description to enable teachers and investigators to build their own microwave oscillators.

Bulletin No. 349, "Performance of a Hot-Water Heating System in the I=B=R Research Home at the University of Illinois." By Alonzo P. Kratz, Warren S. Harris, M. K. Fahnestock, and Ross J. Martin. Issued by the Engineering Experiment Station of the University of Illinois. Until September 15, 1944, or until the supply available for free distribution is exhausted, copies of Bulletin No. 349 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.

This 75-page booklet is the first to be published under a cooperative agreement between the Institute of Boiler and Radiator Manufacturers and the University of Illinois, which was formally approved January 2, 1940. A description of the I=B=R Research Home, which was built in Urbana, Ill., furnished and completely equipped specifically for research work in steam and hot water heating, is given, as well as a discussion of the results of tests made during the 1940-41 and 1941-42 heating seasons. In all tests an oil-fired, cast-iron boiler supplying hot water to a one-pipe, forced-circulation, hot-water heating system with small-tube cast-iron radiators was used in the Research Home. The principal objectives of the tests were to compare the operating characteristics of the heating system when operated (1) with a control system permitting the boiler to be used to heat domestic hot water as well as to supply heat to rooms, and (2) with a control system permitting the boiler to supply heat to the rooms only. Fuel and power savings and room temperature conditions resulting from operating with reduced room air temperatures at night were determined for both methods of control. Incidental studies were made of the heat transmission through walls of the house and radiator recesses, and the effect of radiator location on the temperature distribution and air movement within the rooms. All windows remained closed throughout all tests.

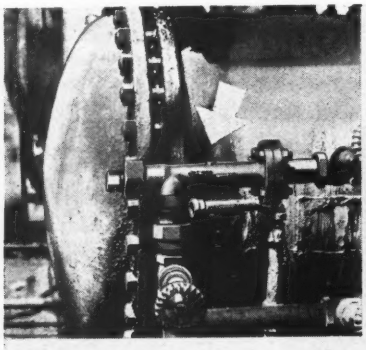
Lighting Handbook. First edition. 175 pp, 5 by 7½ in. semi-flexible cloth. Published by the Westinghouse Lamp Division, Westinghouse Electrical & Manufacturing Co., Bloomfield, N. J. 1943. Price $1.00.

Because of the demand for information on wartime lighting, the Westinghouse Lamp Division has issued this 175 page book on lighting. Originally, it had been scheduled for publication after the war. It is a practical guide and working reference book for lighting engineers, designers, architects and builders.

A feature of the book is a series of charts which coordinate room index, fixture efficiency and coefficient of utilization curves and provides a new and graphic method of determining the desired illumination for various purposes. Charts cover commercial and industrial fluorescent and incandescent lighting and provide a means of calculating quickly the number and size of lamps needed with practically every type of lighting fixture.

The book is divided into two parts, chapter headings in the first section including: Lighting Terms and Measurements, Recommended Levels of Illumination, Interior Lighting Design Calculations, Interior Wiring For Lighting. In the second half of the book, devoted to specific lighting applications, there are chapters covering store, office, school, public buildings, industrial, architectural, aviation and street and highway lighting.

Only a limited number of copies of this book will be available.



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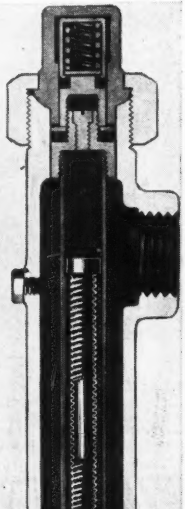

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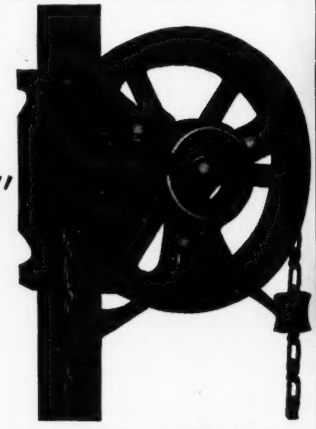

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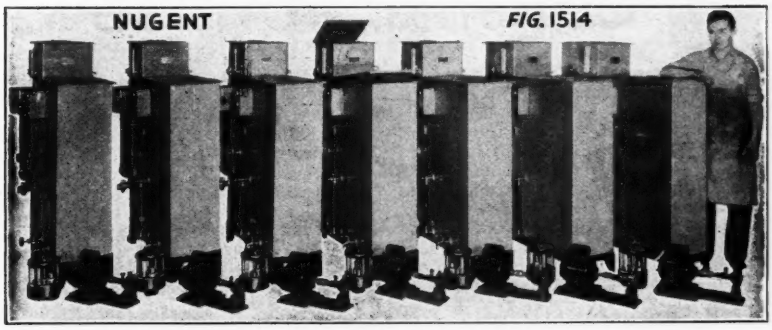

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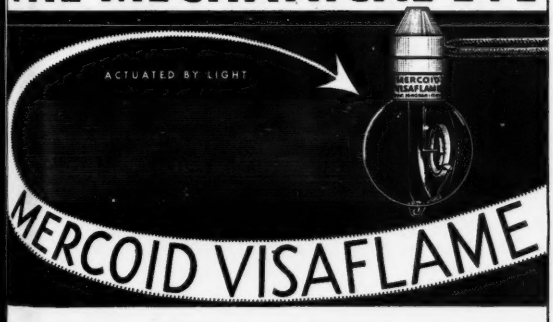

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Power Plant Construction News

Ala., Decatur — Goodyear Decatur Mills, Inc., manufacturer of tire fabrics, will install electric power equipment in new one-story addition, about 280 x 360 ft, for considerable increased capacity. Cost estimated about $1,250,000, with financing in that amount to be provided by Defense Plant Corp., Washington, D. C. Work will be placed under way soon. Robert & Co., Bona Allen Bldg., Atlanta, Ga., are architects and engineers. Company is a subsidiary of Goodyear Tire & Rubber Co., Akron, Ohio.

Ark., Pine Bluff—Arkansas Power & Light Co., Pine Bluff, has plans maturing for new 110,000-v transmission line from Woodward power substation, near Pine Bluff, to Lake Village and vicinity. Cost is estimated approximately $660,000. Permission has been granted and work is scheduled to begin at once.

Ark., Star City — C. & L. Rural Electric Cooperative Corp., Star City, plans extensions in rural electric system, including primary and secondary lines, service connections and other facilities. Cost estimated about $75,000. Financing has been arranged through Federal aid.

Calif., Huntington Park—Sisters of St. Francis of Penance, care of George Adams, 113 East Los Feliz Blvd., Glendale, Calif., architect, will install boiler plant for central-heating service in new three-story hospital at Newell and Saturn Sts., Huntington Park. Entire project will cost about $600,000, of which $400,000 will be secured through Federal aid. Architect noted will be in charge.

Calif., Los Angeles—State Packing Co., 3049 East Vernon Ave., Vernon district, meat packer, plans installation of electric power equipment in new one-story and basement processing and packing plant, 100 x 200 ft, at 3163 East Vernon Ave. Cost reported over $65,000. Project has a priority rating and work is scheduled to begin at once.

Conn., Naugatuck — Naugatuck Chemical Division, United States Rubber Co., Elm St., manufacturer of industrial chemicals, plans several new additions for rubber latex production. Electric power equipment will be installed. Cost estimated over $1,000,000. Project will have a priority rating and will be carried out soon. Fletcher-Thompson, Inc., 211 S. State St., Bridgeport, Conn., is architect and engineer.

Fla., Miami — Miami Cold Storage Co., 1265 North 22nd St., has approved plans for new one-story cold storage and refrigerating plant, reported to cost close to $40,000, with equipment. It is understood that project has a priority rating, with work to begin at early date. L. W. Culter, address noted, is company engineer.

Ill., Elmwood—Water Department, Elmwood, has plans under way for extensions and improvements in water system, including installation of new water-treatment plant, elevated steel tank and other facilities Cost estimated about $65,000. It is understood that application has been made for a priority rating. L. A. Miller, Streator, Ill., is consulting engineer.

Ill., Evanston — Dickson Weatherproof Nail Co., 1515 Sherman Ave., manufacturer of special roofing nails, etc., plans installation of electric power equipment in proposed new one-story addition, about 50 x 125 ft, reported to cost over $80,000. It is understood that application has been made for a priority rating. Perkins, Wheeler & Will, 222 West North Bank Dr., Chicago, Ill., are architects.

Iowa, Burlington—Dr. Pepper Bottling Co., Burlington, soft drinks, plans installation of electric power equipment in new one and two-story bottling plant, 80 x 100 ft, on local site at Parkway and Madison Ave. Cost reported close to $50,000. Project has a priority rating and work will begin soon. Conrad Hamff is general manager.

Ky., Atherton — Cummins-Collins Distilleries, Inc., plans expansion in plant, now given over to alcohol production for Government, with installation of machinery and electrical equipment for by-products animal feed manufacture. Proposed to make extensions in boiler plant, with installation of additional equipment for increased ca-

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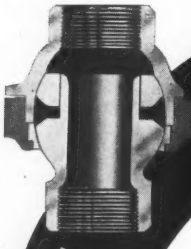

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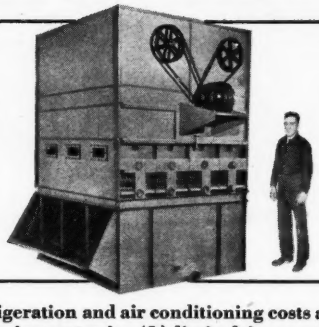

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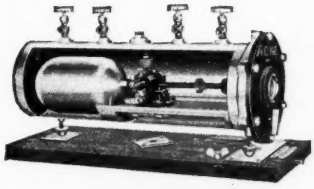

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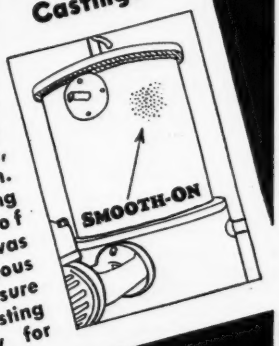

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pacity. Cost estimated about $160,000. Financing will be provided by Defense Plant Corp., Washington, D. C.

Mass., Springfield—Board of Trustees, Springfield College, 263 Alden St., Dr. E. M. Best, president, plans new boiler plant at institution as a postwar project, estimated to cost over $50,000, with equipment. Work will be carried out with other buildings at institution, entire project to cost over $500,000. Charles Collens, 71 Newbury St., Boston, Mass., is consulting engineer.

Minn., Sleepy Eye — Light and Power Department has engaged Ralph D. Thomas & Associates, 1200 Second Ave., So., Minneapolis, Minn., consulting engineers, to make surveys and prepare plans for expansion and improvements in municipal steam-electric power plant, to include installation of new turbine unit, boiler and auxiliary equipment. Cost estimated close to $200,000. It is understood that project will be carried out as a postwar development.

Minn., Worthington — Municipal Electric Department has plans under way for extensions and improvements in municipal power plant, with installation of equipment for increased capacity. Cost reported in excess of $150,000. It is understood that program will be a postwar development, or as soon as equipment and materials are available. Ralph D. Thomas & Associates, 1200 Second Ave., So., Minneapolis, Minn., are consulting engineers.

Mo., Kansas City—Pratt & Whitney Aircraft Corp., Holmes St. and Bannister Rd., manufacturer of airplane engines, will make extensions in plant for increased production for Government, including several new buildings, estimated to cost about $700,000, with machinery. Electric power equipment will be installed. Financing will be provided by Defense Plant Corp., Washington, D. C. Work will begin soon. Company is a unit of United Aircraft Corp., with headquarters at 400 Main St., East Hartford, Conn.

Mont., Glendive—Bureau of Reclamation, Fort Peck, Mont., has plans under way for new transmission line from local hydroelectric generating station to Glendive, about 140 miles, where power will be furnished Montana-Dakota Utilities Co., for local and distant distribution. It is understood that power substation will be built at terminus, for connection with high-tension system of utility company. Project has secured a priority rating. Proposed to begin work soon.

Ohio, Shelby—City Council is considering report made by Froehlich & Emery Engineering Co., Toledo Trust Bldg., Toledo, Ohio, consulting engineer, for extensions and improvements in municipal power plant, including installation of additional equipment for increased capacity. No estimate of cost announced. Engineer noted was engaged recently to make a survey of local situation.

Pa., Ellwood City — United Tube Corp., manufacturer of steel tubing, plans installation of electric power equipment in connection with proposed rebuilding of portion of local plant, recently destroyed by fire, with loss reported over $125,000, including machinery.

Texas, Garland—Continental Motors Corp., manufacturer of aircraft and automobile engines, plans three new additions to local plant for considerable increased output. Electric power equipment will be installed. Entire project is estimated to cost over $200,000. H. B. Gieb & Associates, Texas Bank Bldg., Dallas, Texas, are architects. Main offices of company are at 12801 East Jefferson Ave., Detroit, Mich.

Va., Scottsville—United States Rubber Co., 1230 Sixth Ave., New York, N. Y., will construct and operate new mill at Scottsville, where large tract of land has been acquired, for manufacture of high-tenacity rayon yarns for tire cord production. It will comprise several large units. Electric power equipment will be installed. A boiler house and power substation are planned. Entire project will cost about $2,240,000, and will be financed by Defense Plant Corp., Washington, D. C. Work will begin at once.

Wash., Longview — Owens-Illinois Glass Co., Pacific Coast Division 135 Stockton St., San Francisco, Calif., manufacturer of bottles, etc., plans installation of electric power equipment in proposed new branch plant at Longview, where large tract of land has been acquired. It will be carried out as a postwar project, or as soon as equipment and materials are available, and will comprise several multi-story buildings, with boiler house and auxiliary structures. Cost estimated about $3,500,000. Austin Co., Ray Bldg., Oakland, Calif., is engineer. Main offices are in Ohio Bldg., Toledo, Ohio.

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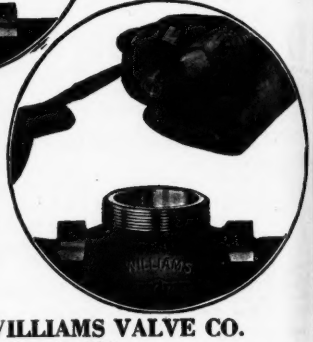

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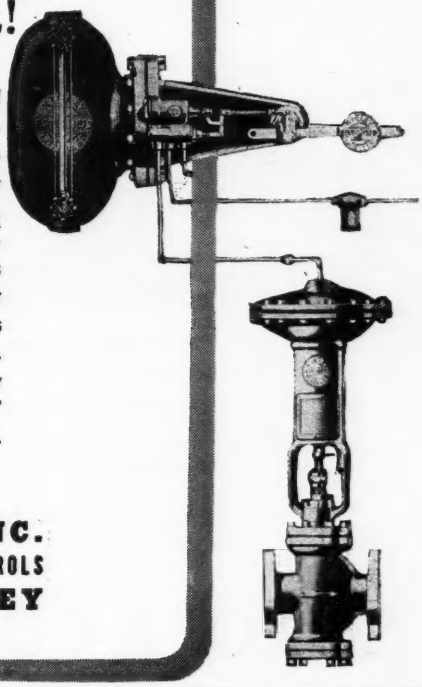

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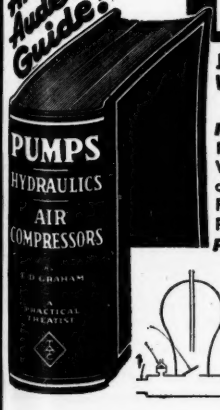

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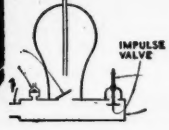

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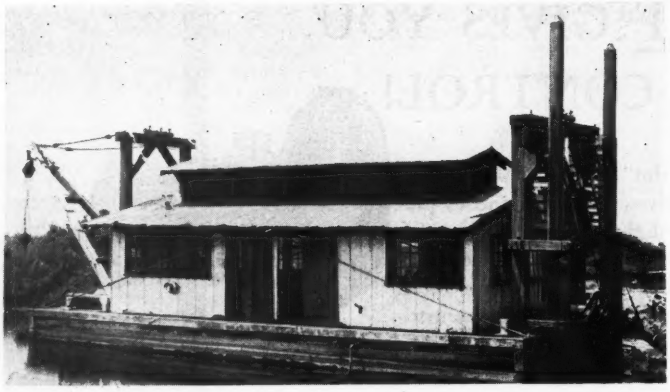

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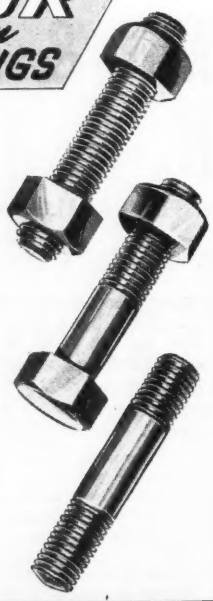

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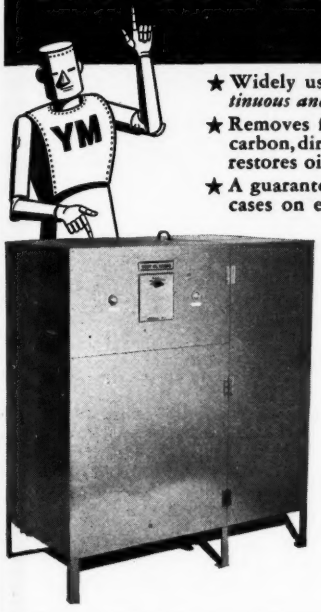

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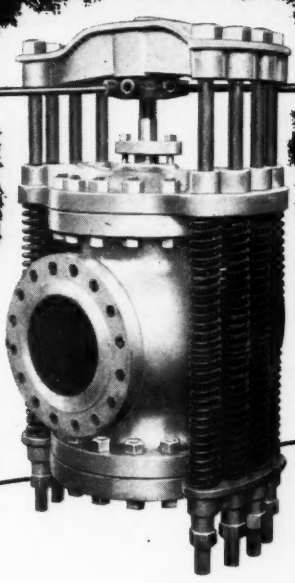

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Allis-Chalmers Mfg. Co. 46, 57
Allpax Co., Inc., The 182
American Blower Corp. 40-41
American Chain & Cable Co., Inc. ... 143
American Chimney Corp. 196
American Coal Burner Co. 152
American District Steam Co. 211
American Engrg. Company 26-27
American Locomotive Co. (Alco Products Division) ..... *
American Pulverizer Co. 189
American Radiator & Standard Sanitary Corp. 40-41
Anderson Co., The V. D. 188
Anderson-Stoltz Corp. ..... *
Arkansas Fuel Oil Co. ..... *
Armor-Clad Company ..... *
Armstrong Machine Works 33
Atlas Valve Co. 172
Audel & Co., Theo. 219

Babbitt Steam Specialty Co. 214
Babcock & Wilcox Co., The 42-43
Babcock & Wilcox Tube Co., The ... 169
Bacharach Ind. Inst. Co. ..... *
Bailey Meter Co. 18-19
Baldwin-Hill Co. 166
Baldwin Locomotive Works ..... *
Beaumont Birch Company 190
Belmont Packing & Rubber Co., The *
Bendix Aviation Corp. ..... *
Betz, W. H. & L. D. ..... *
Biddle Co., James G. 154
Bird-Archer Co., The 131
Blackmer Pump Co. 208
Bowser, Inc. 62
Brickseal Refractory Co. ..... *
Bridgeport Brass Co. 64
Briggs Clarifier Co. 141
Brown Instrument Co., The 52
Brunt Equipment Co. ..... *
Burgess-Manning Co. ..... *
Busch-Sulzer Bros. Diesel Engine Co. 32

Canton Stoker Corp. ..... *
Cash Company, A. W. 151
Chapman Valve Mfg. Co., The ..... Inside Back Cover
Chesterton Co., A. W. 178
Chicago Metal Hose Corp. ..... *
Cities Service Oil Company ..... *
Cleaver-Brooks Co. 181
Clipper Mfg. Co., The 200
Coal Bureau—Upper Monongahela Valley Association ..... *
Cochrane Corporation .. 47, 145, 199, 204
Combination Pump Valve Co. 194
Combination Control Corp. ..... *
Combustion Engrg. Co., Inc. 24-25
Condenser Service & Engineering Co., Inc. 58
Connery Construction Co. 209
Cook's Sons, Inc., Adam ..... *
Corning Glass Works ..... *
Crane Co. 121
Crane Packing Co. ..... *
Crocker-Wheeler Elec. Mfg. Co. 183
Cutler-Hammer, Inc. ..... *

Dampney Company of America, The *
Dart Mfg. Co., E. M. 164
Davis Regulator Co. 221
Dean Hill Pump Co. ..... *
Dearborn Chemical Co. 135
De Laval Separator Co., The 60
De Laval Steam Turbine Co. ... 53, 196
Detrick Co., M. H. ..... *
Detroit Stoker Co. ..... *
Dowell, Incorporated ..... *

Ebner Ice & Coal Storage Co. 182
Edge Moor Iron Works, Inc. 173
Edward Valve & Mfg. Co., Inc., The. 119
Electric Chemical Co. ..... *
Elgin Softener Corp. ..... *
Elliott Co. 2-3
Engineer Co., The 170
Ernst Water Column & Gage Co. 219
Ess Instrument Co. ..... *

Fairbanks Co., The 136
Fisher Governor Company 159
Flexitallic Gasket Co. ..... *
Flexrock Co. 212, 215
Flynn & Emrich Co. ..... *
Foster Engrg. Company ..... *
Foster Wheeler Corp. 20-21
France Packing Co., The ..... *
Fuller Company 162

Garlock Packing Co., The 34
Garratt-Callahan Co. 212
General Coal Co. ..... *
General Electric Co. 35-38, 133
Gifford-Wood Co. ..... *
Gilmer Company, L. H. 175
Globe Steel Tubes Co. ..... *
Goetze Gasket & Packing Co., Inc.. *
Golden-Anderson Valve Specialty Co. 210
Grinnell Co., Inc. 199
Griscom-Russell Co., The 22

Haering & Co., Inc., D. W. 196
Hagan Corporation 12-13, 44-45
Hall Laboratories 12-13, 44-45
Hays Corporation, The 123
Hendy Iron Works, Joshua 55, 137
Henszey Company 150, 158
Hercules Float Works ..... *
Hills-McCanna Co. ..... *
Honan-Crane Corp. 180
Huyette Co., Inc., The Paul B. .... *

Infilco, Incorporated ..... *
Ingersoll-Rand Co. ..... *
International Nickel Co., Inc., The. 157
Iron Fireman Mfg. Co. 14-15

Jenkins Bros. ..... *
Johns-Manville 50
Johnson Service Company 179

Keasbey & Mattison Co. 177
Kellogg Co., The W. M. 193
Kennedy Valve Mfg. Co., The 140
Kieley & Mueller 219

Ladish Drop Forge Co. ..... *
Leavitt Machine Co., The 142
Leeds & Northrup Company ..... *
Link-Belt Co. ..... *
Liquidometer Corp., The 210
Lummus Co., The 39
Lunkenheimer Co., The 117

Manzel Bros. Co. 220
Marley Company, Inc., The 65
Mason-Neilan Regulator Co. 138
Maxim Silencer Company, The 9
McAlear Manufacturing Company .. *
McGraw-Hill Book Co., Inc. 213
Mercoid Corp., The 215
Midwest Piping & Supply Co., Inc.. 23
Miller Tool Sales, J. C. 218
Minneapolis-Honeywell Regulator Co. 52
Murray Iron Works Co. 184

National Aluminate Corp. 115
National Valve & Mfg. Co. ..... *
Niagara Blower Co. ..... *
Nicholson & Co., W. H. 192
Northern Equipment Co. 125
Norton Company 195
Nugent & Co., Inc., Wm. W. 215

Oakite Products, Inc. 200
Ohio Injector Co., The 146

Pennsylvania Crusher Co. 217
Permutit Co., The ..... Back Cover
Philadelphia Gear Works ..... *
Pipe & Tube Products, Inc. 174
Porter Co., Inc., H. K. 190
Powell Co., The Wm. 134
Powers Regulator Co., The 198
Prat-Daniel Corp. 191
Pritchard & Co., J. F. ..... *
Proportioneers, Inc. 201

Quaker Rubber Corporation 211
Quimby Pump Co., Inc. 190

Raybestos-Manhattan, Inc. ..... *
Reading-Pratt & Cady Div. of American Chain & Cable Co., Inc. 143
Refinery Supply Co., Inc. 217
Reliance Gauge Column Co., The .... *
Rempe Co. 192
Republic Flow Meters Co. 30
Richardson Scale Company 207
Roto Company, The 186
R-S Products Corp. 168

Sarco Company, Inc. 214
Scovill Mfg. Co. 155
Shell Oil Co., Inc. 139
Simplex Valve & Meter Co. 56
Sims Company, The ..... *
Sinclair Refining Co. 59
Skinner Engine Co. ..... *
Smooth-On Mfg. Co. 217
Socony-Vacuum Oil Co., Inc. 16-17
Sokol & Company 220
Springfield Boiler Co. 51
Squires Co., The C. E. 220
Steel Improvement & Forge Co. ... *
Stephens-Adamson Mfg. Co. 61
Sterling Engine Co. 149
Stonhard Co. 209
Strong, Carlisle & Hammond Co. .. 213
Struthers Wells Corp. ..... *
Superior Railway Products Corp. ... 216
Sun Oil Company 127
Swartwout Co., The 194
Syntron Company ..... *

Talon, Inc. ..... *
Taylor & Co., W. A. ..... *
Taylor Forge & Pipe Works 144
Terry Steam Turbine Co., The 48-49
Texas Co., The 4
Tide Water Associated Oil Co. 28-29
Todd Shipyards Corporation (Combustion Equipment Division) 161
Treasury Department 148
Troy Engine & Machine Co. 171
Tube-Turns, Inc. 129

Union Iron Works ..... *
U. S. Machine Corp. 197
United States Rubber Co. 54
Union Asbestos & Rubber Co. 203
Victor Products Corp. 220
Viking Instruments, Inc. 202
Vogt Machine Co., Inc., Henry 153

Wabash Portland Cement Co. ..... *
Warren Steam Pump Co., Inc. 147
Water Treatment Co. of America .. *
Watson-Stillman Co., The 163
Westinghouse Elec. & Mfg. Co. 63
Wheeler Mfg. Co., C. H. 31
Wickes Boiler Co., The ..... *
Williams Gauge Co., The 160
Williams Valve Co., The D. T. 218
Wilson Co., Thos. C. 176
Wing Mfg. Co., L. J. 165
Worthington Pump & Machy. Corp. . 167

Xzit Sales Corp. 202

Yarnall-Waring Co. 10-11, 66, 156
Yeomans Bros. ..... *
Young Radiator Co. 216
Youngstown Miller Co., The 221

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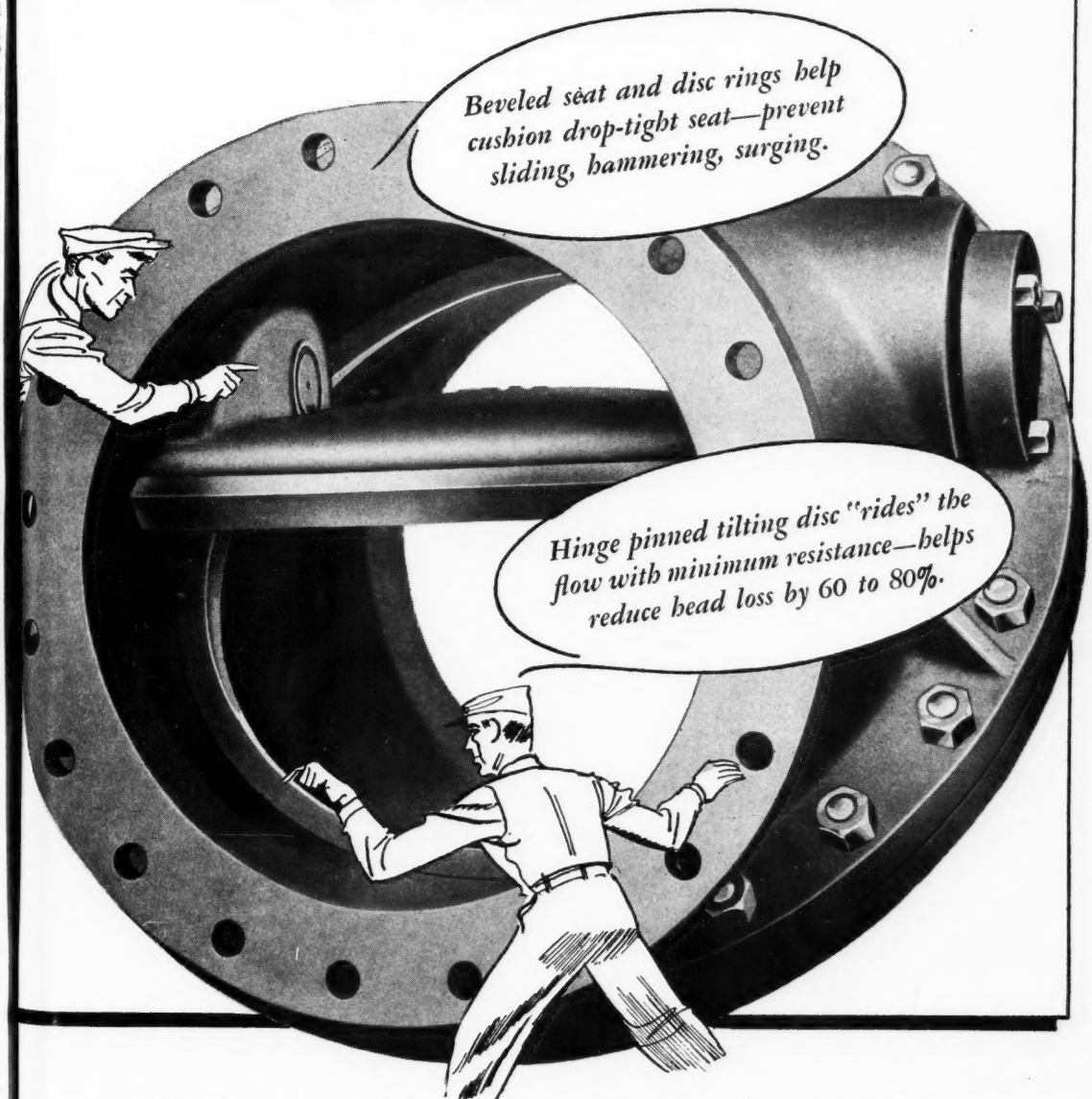
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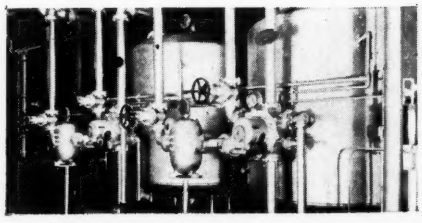
ally efficient on horizontal or verti- cal installations on water, steam, oil, gas and air lines

"Driving our boilers hard...but good water keeps 'em clean!"

Permutit prevents scale and corrosion

Permutit-conditioned water—free of hardness and other impurities—is keeping boilers off the sick list at thousands of war plants. Typical comment on Permutit installations: "After operating a full season we find no scale, no corrosion . . . boilers clean as new metal."

If *you* have a water problem, Permutit's 30 years of experience in this field will be valuable to you. Just drop a line to The Permutit Company, Dept. A, 330 W. 42nd St., New York 18, N. Y. In Canada: Permutit Company of Canada, Ltd., Montreal.



Permutit Zeo-Karb* H Water Conditioner removes both hardness and bicarbonates from water. Effluent contains no incrustants, is reduced in total solids and alkalinity. Alkalinity can be adjusted by mixing effluents from a Zeo-Karb H unit and a sodium zeolite unit.

*Trademark Reg. U. S. Pat. Off.

Serving industry and the armed forces... with GOOD WATER

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WATER CONDITIONING HEADQUARTERS